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ELECTRIFICATION ON THE NORFOLK AND WESTERN RAILWAY.

EQUIPMENT OF THE VIVIAN-BLUEFIELD SECTION WITH SINGLE-PHASE TRANSMISSION AND THREE-PHASE MOTORS.

The electrified section of the Norfolk and Western Railway, known as the "Elkhorn Grade," is situated on the main line in the southern part of West Virginia, about 105 miles west of Roanoke, and extends from Vivian to Bluefield, a distance of about thirty miles. An outline map of the section is shown in Fig. 2. The section has double tracks throughout, except in the Elkhorn tunnel, which has a single line. There is also a third track, or passing sidings, and branches, into the coal workings and railway yards. The grades on the line (Fig. 3) are heavy, varying from 1·0 per cent. at the west end to 1·5 to 2 per cent. up the grade, to and through the summit tunnel, a distance of about ten miles; thence the line descends on a 2·5 per cent. grade for about a mile, and then rises again at the ruling rate of about 0·25 per cent. for 10·5 miles, and finally up a 1·22 per cent. grade for three miles into Bluefield, the eastern end of the division. Fully 60 per cent. of the line is on curves, the maximum being about 12 degrees. The electrification of this section has been carried out primarily for the purpose of collecting from the mine sidings and yards in the coalfields the entire eastbound coal tonnage, and transporting it up the grades and over the summit to the sorting yard at

Fig. 1.—Power Station from the West, showing Inspection Building (left), Coal Delivery Track, and Coal Elevator.

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Bluefield, the division point of the railway. From Bluefield, after sorting, it is shipped east to various destinations, chiefly to the Railway Company's marine shipping pier at Lambert's Point, near Norfolk, Virginia. All coal traffic originates west of Flat Top, about six miles east of the summit of the heavy grade, and although a good deal of the coal goes west, the easterly shipments are very heavy, and this constitutes the chief load handled on the electric section. Some coal obtained east of the summit is shipped to the west, and this is also handled by the electric service to yards near the western end of the electrified section.

There are numerous colliery sidings throughout the coalfields, and the electric service includes the picking up of loaded cars or trains from these sidings on the eastbound trip and the delivery of empties on the return trip. It will thus be seen that the electrified section is practically a short haul division between the coalfields and Bluefield, operated to a large extent independently of the other traffic of the main division. In addition to the heavy coal traffic, however, through goods and passenger services over the electrified section, which is still worked by steam road engines, is also carried on in part by electric locomotives, which are used as pushers or helpers up the grades. Another condition favourable to electric traction is that trains may be despatched at fairly uniform intervals throughout the day, and thus desirable loading conditions on the power system are obtained, and at the same time the full service is maintained with a moderate number of locomotives, each making several round trips per day.

The purpose of the company in electrifying this section was to increase the capacity of the railway by materially reducing the time required to handle trains, and to provide a more economical and efficient service over the heavy gradients. To this end the heavy freight trains are drawn by electric locomotives at a running speed up the grades of 14 miles per hour, as compared with about 7½ miles per hour under steam operation ; and a further saving in time is also effected by the elimination of the delays hitherto occasioned by steam trains occupying the tracks while the engines take on fuel and water, one at a time, at the several stations on the gradient. The effect of increased speed is especially marked at the single track Elkhorn Tunnel, 3,000 ft. long, on 1·5 per cent. grade, where on account of ventilation requirements it has been necessary under steam operation to reduce the speed up the grade in the tunnel to about 6 miles per hour. This requires about seven minutes to clear the block, whereas under electrical operation it only takes about three minutes.

The heavy coal trains, known as " tonnage trains," handled in this service weigh 3,250 tons, and have formerly been hauled up the grade by three steam locomotives, a road engine and a helper, one at each end of the train, being used over the entire section, and a pusher helping at the rear up the 1·5 and 2 per cent. grades being cut off at the summit. These steam engines are of the highly developed heavy Mallet type, fitted with mechanical stokers and superheaters. Under electrical operation a single road engine is used over the division, and a second electric engine is used as a pusher up the 1·5 and 2 per cent. grades. Thus it will be seen that one electric engine takes the place of two Mallets over the division, and two electric engines take the place of three Mallets up the grades, and work the train approximately in half the time. The speed at which the electric locomotives draw the trains on the 0·4 per cent. grade between Cooper and Graham is 28 miles per hour.

The electrical installation has been laid out and the power plant, locomotives, and other equipment provided for running 20 coal trains, or 65,000 tons, a day eastbound over the division, and ample provision has been made for additional traffic and extensions when required. The number of these coal trains every day at present is about twelve, in addition to which pusher and helper service is provided for through freight and passenger trains.

The single-phase system of transmission is used, power being generated, transmitted, and distributed single-phase at 25 cycles, and collected from the overhead catenary trolley contact system at 11,000 volts. The locomotives, however, are unique in that they are equipped with phase converters which, in connection with the main step-down transformers on the locomotive, transform the single-phase power of the trolley to three-phase power for use in the three-phase induction type traction motors. Thus, while retaining all the advantages of high voltage single-phase distribution and collection, the advantages of three-phase induction motors for these heavy-traction mountain-grade conditions are also secured.

Another characteristic feature of the installation is the fact that, as the result of the use of traction motors of the polyphase induction type, it is feasible without the use of additional or complicated apparatus and devices to utilise the locomotives for electrically holding or braking the trains at constant speed while descending grades. This utilises the energy in the moving train descending the grade to drive the motors as generators, and thereby returns energy to the line.

This kind of electric braking or " regeneration " has been much discussed, but with the exception of the Giovi line in Italy this feature has not been utilised in any extensive commercial electric railway operation. Even on the Giovi line the train weights do not exceed 400 tons, and it is evident therefore that this is the first instance where the use of this form of electric braking has ever been attempted for heavy freight train service, such as obtains on American railroads. On the Elkhorn Grade the conditions are such that the full advantages of this form of braking can be secured, as the trains are very heavy, the grades are severe, and the speeds are relatively high. The performance of this feature of the installation has proved highly satisfactory under operating conditions, the heaviest trains being handled down the mountain grades with a single engine at a uniform speed of about 15 miles per hour and with the utmost ease, the air brakes being held in reserve for bringing the train to a standstill when required. This results in a large reduction in the wear on brake shoes and wheel tires, and in wear and tear on draught gear and on the cars and locomotives generally. While the above is the principal advantage obtained from regenerative braking, there is also some saving in power due to the return of energy to the line, which is available for helping the power station to supply power to other trains should it be required.

Next to the electric locomotives, the most interesting feature of the electrification is probably the catenary line construction. In designing this feature of the installation, the engineers had uppermost in mind the two important requirements of reliability of service and low cost of maintenance. An effort has been made to secure the maximum degree of flexibility and freedom from hard spots at the contact wire, so as to avoid rapid deterioration and frequent breakages and failures, and a special effort has also been made to provide the highest type of insulation so as to avoid interruptions to service due to insulation breakdowns.

In designing the supporting structures, an effort has been made to secure a structure of neat and attractive appearance, which would not interfere with the view of signals, and which would present the least surface for

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corrosion and minimise the cost of painting and repairs as well as the first cost of installation. In working out the design on these lines, the catenary system has taken the form of single catenary with an auxiliary messenger wire above the trolley, one main hanger being provided for every two intermediate connections between auxiliary and trolley on tangents. On curves the angularity of the hangers provided the necessary flexibility, the auxiliary messenger and trolley wire being connected to the hanger at the same point.

The principle of providing more than one single insulator between live parts and ground has been adopted, and suspension insulators are used throughout as being the least liable to fail owing to transverse

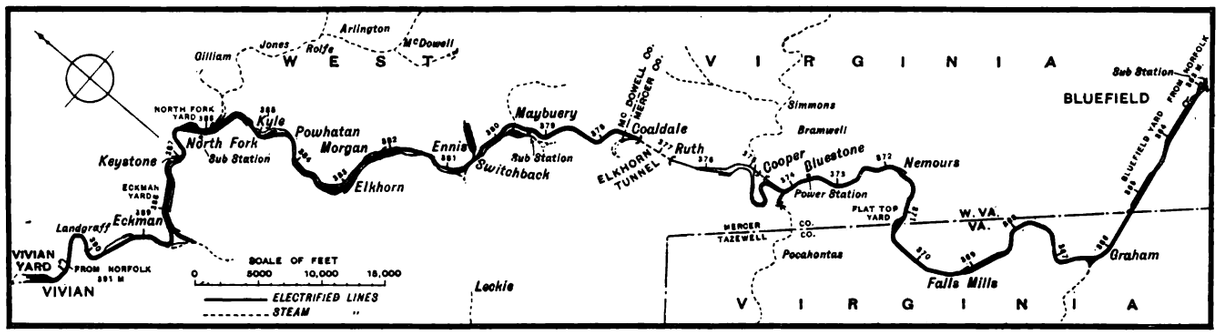

Fig. 2.—Outline Map of Electrified Section (Vivian-Bluefield) of the Norfolk and Western Railway.

stresses. Care has also been taken to guard against failures due to unequal expansion and contraction resulting from temperature changes. For the main line tracks three suspension insulators are connected in series, so that the failure of one or even two at any point will not result in the complete breakdown of the insulation and interrupt the service. For the yard tracks and sidings two such insulators are used.

Great care has been taken also to provide ample clearance between every live part and adjacent grounded structures, and as a rule this clearance is maintained at not less than 18 inches, so as to avoid the danger of birds or foreign materials causing a short circuit. The same principle applies in the tunnels, where the insulators are, however, shifted to one side, out of the direct blast from locomotive chimneys, and here two 44,000 volt transmission line insulators in series are used in all cases between live points and ground.

The line supports are light bridges made of tubular poles and "H" section crossbeams, and the structures to resist the curve pull are guyed on the outside of curves by means of two heavy guy rods secured in concrete anchorages. At signal bridges the signals and catenary system are supported on structural bridges, which consist of latticed posts carrying shallow plate girders, which form as little obstruction to the view of signals as possible, and are easily painted and maintained. The same type of bridge is used on curves where it is impossible to provide guys at the outside of the curve.

In laying out the electrical installation a great deal of attention has been given to the provision of adequate and convenient facilities for the inspection and maintenance of all parts of the installation. The centre and headquarters of the whole system is at Bluestone, where, on account of the water supply, the power-house is of necessity situated; and after much study it was decided to place the inspection building and machine shop for maintenance of electric locomotives here also, rather than to do the work on electric engines at the steam engine shops at Bluefield. The headquarters of the line maintenance staff is also at Bluestone, and is in constant touch, by means of a patrol telephone line and telephones placed at signal bridges, with all parts of the electrified section, in addition to the usual telephone facilities. Thus the general foreman and the foremen of all departments of the electrical maintenance work are stationed at one central point, and are provided with means by which constant connection is maintained with all points, including train despatchers, yard masters, and the superintendent and other division heads. The company has also provided dwellings for foremen and others on its property near the power-house.

In addition to the direct advantages and savings resulting from the electric train service, the railway has taken advantage of the presence of an adequate power supply at net cost of generation for the operation of various auxiliary plants. Thus a large steam pumping station at Bluestone for the water supply for steam locomotives has been shut down, and the pumping is done at the electric power station near by; also the fans for ventilating the Elkhorn Tunnel will now be driven by electric motors. Further electric power will be ultimately used for operating shops and pumps at Bluefield and several other points on the division.

The electrification of this section had long been under consideration, but the decision to electrify was not reached until about two years ago. The layout and

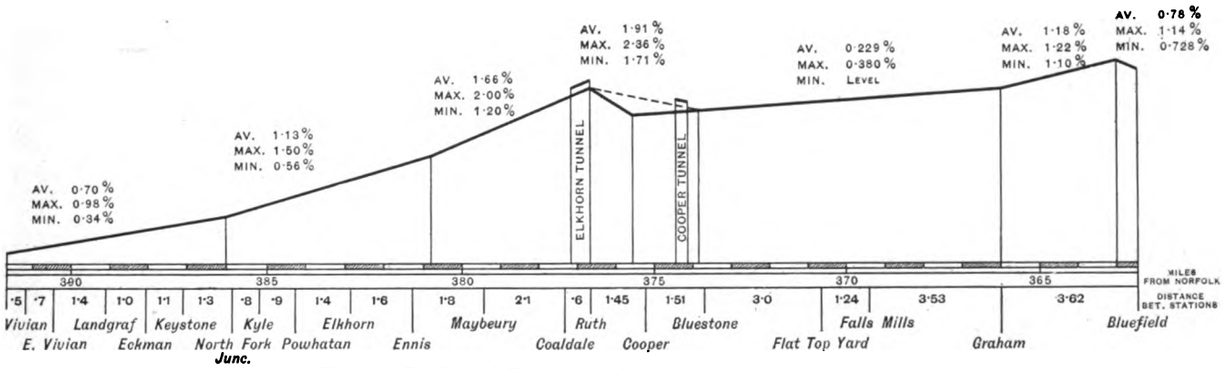

Fig. 3.—Profile of Electrified Section—Vivian to Bluefield.

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design of the entire installation was worked out in all details by Messrs. Gibbs and Hill, of New York, engineers for the company. All construction, excepting the power-house buildings and some of the power-station equipment, was carried out by a specially organised railway staff under the supervision of the engineers.

POWER STATION.

The power station is of the usual type, with steam boilers and steam turbines as the prime movers. It is situated at Bluestone, on the Bluestone River, about 11 miles west of Bluefield, mainly for the reason that here is almost the only available source of water for boiler feed and condensing purposes in the district, while the railway company had already constructed a dam and reservoir here for the water supply for its steam locomotives. General views of the station are given in Figs. 1 and 4. The building is constructed of hard burnt brick ; the design is plain and substantial in character. The main structure is about 158 ft. by 135 ft., with a 52 ft. by 33 ft. extension at the north-east corner. The main building contains a boiler-room 158 ft. 6 in. by 70 ft. 3 in. (Figs. 5 and 6), and a turbine-room 158 ft. 6 in. by 56 ft. (Figs. 8 and 9). Across the east end of the turbine-room a section 26 ft. wide is assigned for switching equipment, offices, and other facilities, and it is fitted with intermediate floors and galleries. On the second, or mezzanine floor, of this section are placed the locker and toilet rooms for the engineers and stokers. Above this, on the next floor, is the low tension switching-room, which is separated from the turbine-room by heavy wire screens. On the next floor is placed the operating gallery, overlooking the turbine-room, and a small office and lavatory. The top gallery is used for offices.

The boilers, stokers, stoker engines, and feed water heaters are on the first floor of the boiler-room, while the pumps, oil filters, air compressor, ash handling equipment and the forced draught fans are on the ground floor, the pumps and filters being in a separate room. The main material store-room also occupies a separate room extending along one side of this floor. The main turbo-generator units, exciters, and signal generators are situated on the first floor of the turbine-room, the condenser equipment and fans for cooling the generators being in the basement. The turbine-room is spanned by a 30-ton travelling crane. The lowest floors are at the ground level, while the turbine-room floor is 18 ft. and the boiler-room floor 13 ft. 6 in. above.

On the first floor of the extension building or transformer house are the step-up and step-down transformers, and on the second floor is placed the high tension switching apparatus.

Coal Handling.

Coal is received in hopper bottom cars on a siding along the south side of the power station. The cars discharge into a 24 ft. by 16 ft. structural steel hopper under the tracks (Fig. 1). Below the hopper is a single roll crusher, which empties into an inclined conveyor of the continuous bucket type, having a capacity of about 60 tons per hour at a speed of 80 ft. per minute. This conveyor (Fig. 1) lifts the coal about 60 ft. to a hopper at the east end of the boiler-room clerestory. From this hopper the coal is fed to a horizontal distributing conveyor, which has a capacity of 60 tons per hour at a speed of 100 ft. per minute. The distributing conveyor extends longitudinally through the boiler-room clerestory and is of the travelling scraper type, having 18 in. by 8 in. flights of $\frac{1}{4}$ in. steel plate. The coal is distributed to the storage bins by means of nine hand wheel operated gates. The two storage bins are made of $\frac{3}{8}$ in. open hearth steel plate, and are suspended above and between the boilers from the building girders. Their capacity is about 350 tons. The coal handling machinery is driven by A.C. motors, the crusher motor having a rating of about 35 H.P., the conveyor motor 15 H.P., and the horizontal conveyor motor 10 H.P.

Ash Handling.

A narrow gauge (24 in.) track is laid under each row of boiler ash-hoppers in the boiler-room floor. Steel platform cars, carrying two buckets of one cubic yard capacity each, are pushed along these tracks and loaded by gravity from the ashpit hoppers. They are then run outside the boiler-room basement to a loading trolley. This trolley is carried on a steel trestle which spans two siding tracks (Fig. 4). It is about 110 ft. long, and can accommodate three gondola cars on each track. The buckets are lifted from the small platform cars and emptied into the gondolas by means of a travelling electric hoist. Each hoist can handle a working load of 3,000 lbs., the vertical elevating speed being 30 ft. and the travelling speed is 200 ft. per minute. The hoists are controlled from the ground by means of operating arms carried on outriggers. The buckets are of the self-dumping self-righting type. The present installation comprises four small steel platform cars, each carrying two buckets of one cubic yard capacity each and two travelling electric hoists. The hoist motors are 220 volt D.C.

Boilers and Stokers.

The boiler plant (Figs. 5 and 6) comprises ten Stirling-type water-tube boilers, arranged in two rows with the firing aisle between, each row consisting of two batteries of two boilers each and one single boiler. Space is provided in the present building for four additional boilers. The boilers are designed for a working gauge pressure of 225 lbs., and each has a total effective heating surface of 6,772 square feet comprised in three steam drums 42 in. in diameter and 16 ft. $4\frac{1}{8}$ in. long, and 487 tubes $3\frac{1}{4}$ in. in diameter. The boilers are equipped with superheaters capable of superheating the steam 150 deg. F. at normal rating.

Each boiler is fitted with an underfeed stoker of sufficient capacity to evaporate 61,000 lbs. of water per hour into steam at 200 lbs. gauge pressure 150 deg. F. superheat when supplied with feed water at 200 deg. F. The stokers are equipped with continuous dumping and clinker breaking grates, which discharge directly into the ashpit hoppers. Each row of stokers is driven by two automatic steam engines, each of which is capable of operating ten stokers running at maximum load. The stokers are capable of developing 300 per cent. of normal boiler rating, when burning coal having a heating value of 12,250 B.T.U.'s per pound.

Boiler Feed.

Steam from the exhaust header is discharged into two horizontal Cochrane feed water heaters and purifiers on the boiler-room floor. These are of the cylindrical type, 10 ft. long and 8 ft. in diameter, and are arranged to operate as a double unit. Each heater has a total tray surface of 175 square feet, made up of 80 cast-iron trays, each 21 in. by 15 in., and is capable of heating 225,000 lb. of water per hour from 40 deg. to 205 deg. Fahr. The heaters are equipped with oil separators.

The feed water is taken from the intake canal and pumped to the heaters by two lowhead pumps of the horizontal volute single-stage double-suction type, having a capacity of 650 gallons per minute against a head of 45 ft. when operated at 1,800 revolutions per minute. These pumps are direct connected to 20 H.P. steam turbines. There are two suction lines to the lowhead pumps, each containing a Legonda strainer. From the heaters the water flows to the two boiler feed-pumps, which are of the horizontal volute

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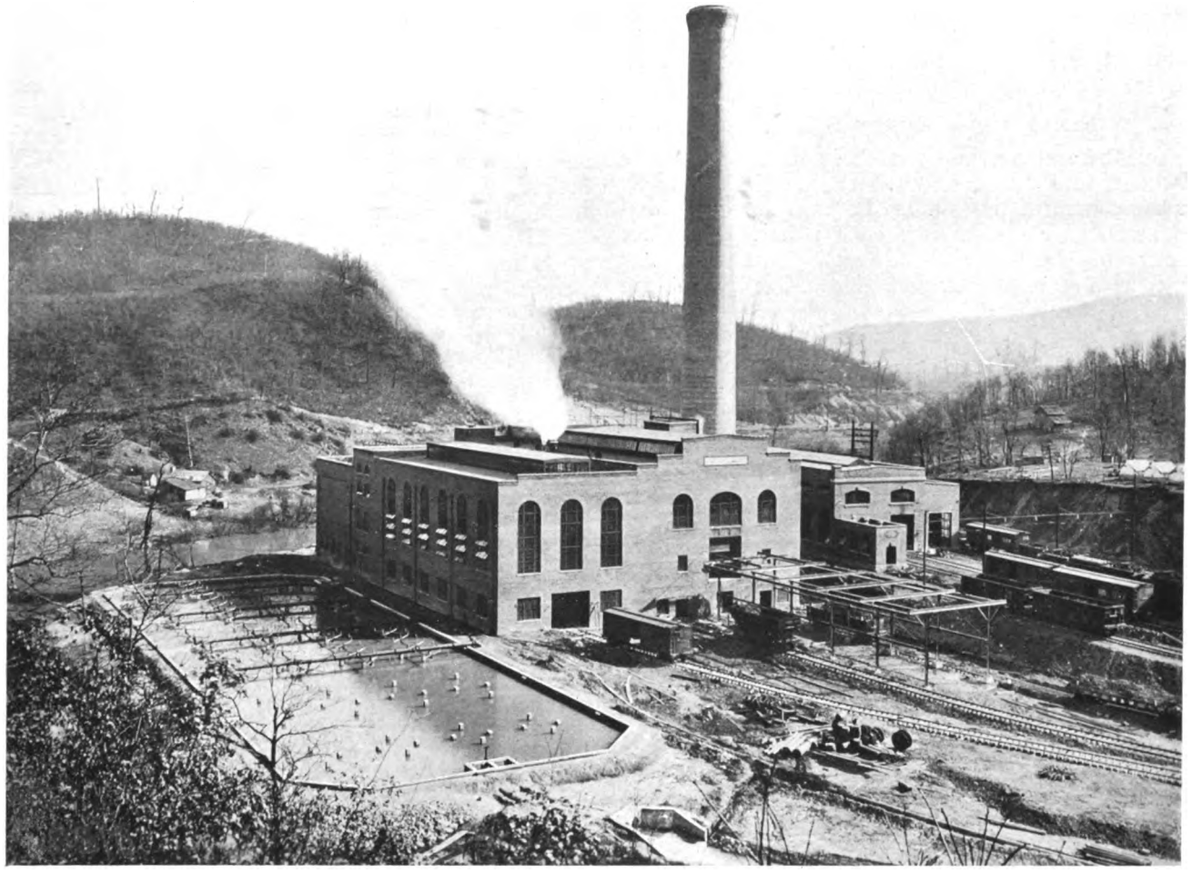

Fig. 4.—Power Station from the East, showing Cooling Pond with Outlet, and Ash Removal Trestle.

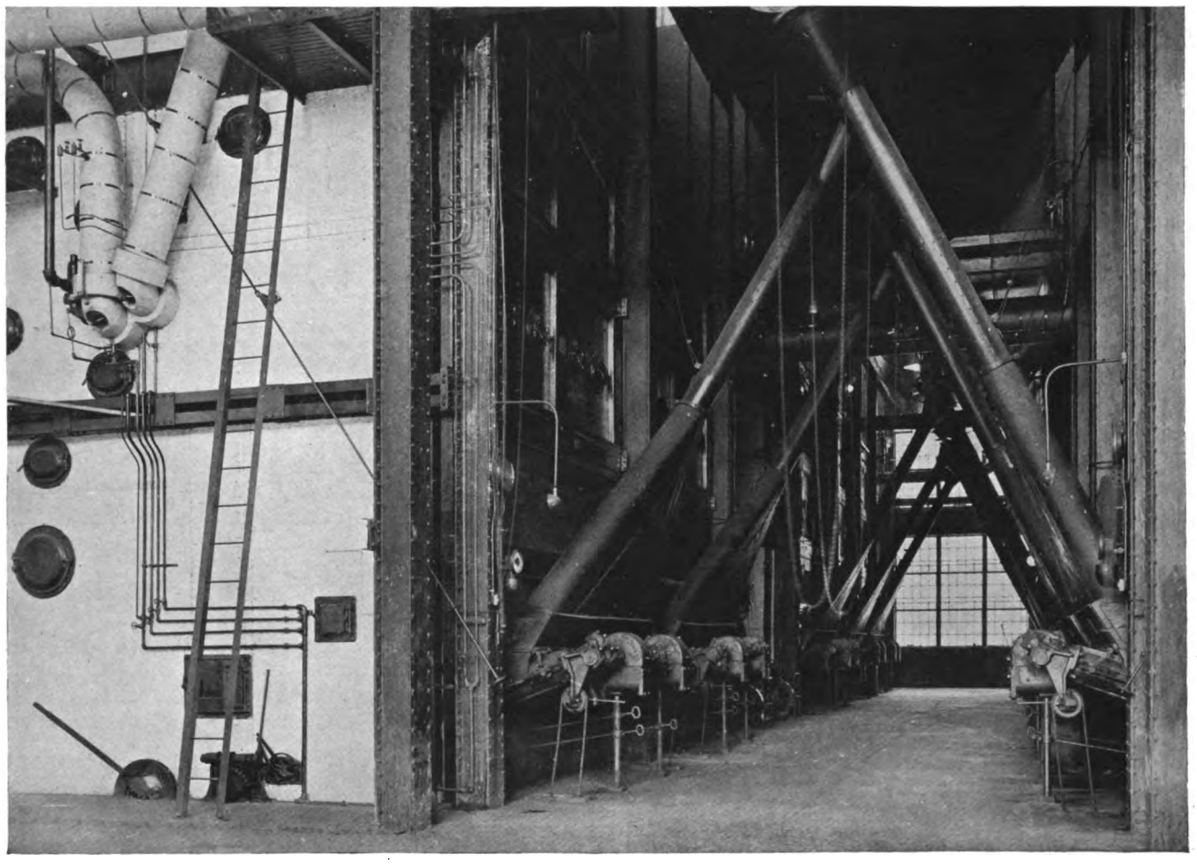

Fig. 5.—Boiler Room, showing Stokers and Coal Bunker.

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three-stage double-suction type, designed to operate against a working head of 600 ft. They have a capacity of 650 gallons per minute against a head of 600 ft. when operated at 2,750 revolutions per minute. These pumps are driven by 175 H.P. steam turbines.

Flues and Chimney Stack.

The flues run along the north and south walls of the boiler-room, and are connected to the main flue at about the centre of the room. Dampers are provided in the breeches connection of each boiler. The flues are made of sheet-iron, lined with asbestos blocks covered with retort cement. Expansion joints are provided in the flues.

The stack is of the Custodis radial brick type, 268 ft. in height from the base or 250 ft. from the grates, with a minimum inside diameter of 20 ft. A 4 in. brick lining extends 75 ft. from the bottom of the flue, opening with a 2 in. air space between the lining and the column. A 36 in. by 24 in. clean-out door is provided about 14 ft. above the ground opposite the flue opening. There is a reinforced concrete floor about on a level with the boiler-room floor, and a door at the ground floor level which gives access to the store-room thus formed in the base of the stack.

Draught.

The forced draught installation in the boiler-room basement consists of three Sturtevant multivane turbine-driven fans. These are of the manufacturer's No. 12, seven-eighths housed type, with double inlets and upward discharge. The fan wheels are 58¼ in. in diameter, each having 48 curved steel blades 60 in. wide. The casing is of sheet-steel, suitably stiffened and braced to prevent vibration.

The fans are driven by steam turbines through a 4 : 1 herringbone reduction gearing. These turbines are of the standard Sturtevant E-5 type, and have a normal rating of about 300 H.P. each. The rated capacity of each fan is 150,000 cubic feet of free air per minute against a static pressure of 6 in. of water when running at 540 revolutions per minute. All three fans feed into the main duct, which has a branch to each boiler. Space is provided for another fan. In addition to the hand control by the dampers at each stoker, the air supply is controlled by an automatic regulator operating on the throttle valve of the fan turbines.

Steam Turbines and Condensers.

The initial equipment consists of three main generating units (Fig. 8), and space has been provided for a fourth. These units are horizontal turbines of the Westinghouse-Parsons impulse reaction double flow type, rated at 10,000 K.W. with steam at 190 lb., superheated 150 deg. Fahr., and 28½ in. vacuum when running at 1,500 revolutions per minute.

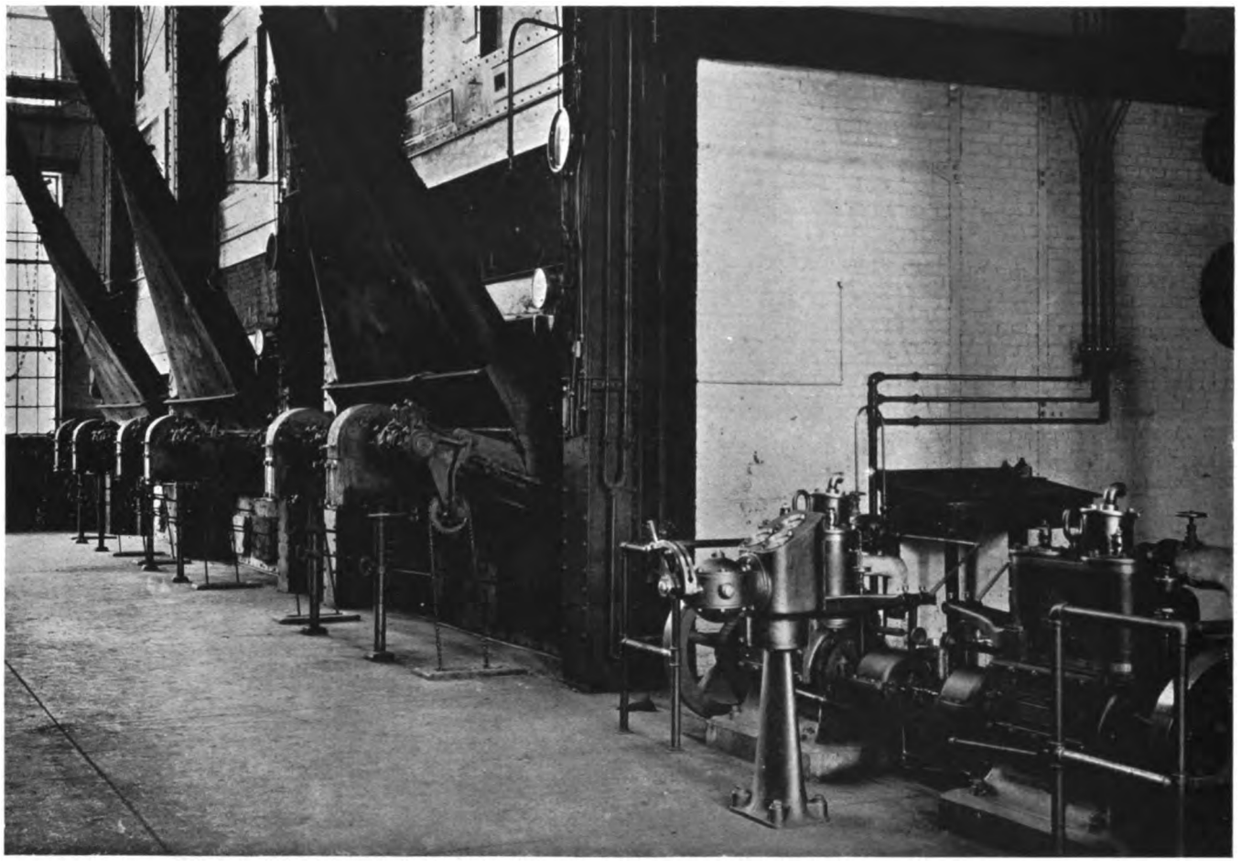

Fig. 6.—Boiler Room, showing Underfeed Mechanical Stokers.

The governor consists of an oil relay mechanism for operating the steam valves. Oil is maintained at a pressure of 45 lb. for the governor mechanism, and reduced to about 10 lb. for lubrication. In case of interruption to the oil supply, the stop valve automatically and instantly operates and shuts off the steam supply. A simple speed limit governor trips the automatic stop valve whenever the speed of the turbine exceeds a predetermined value.

Each turbine is equipped with a separate condenser of the Le Blanc jet type (Fig. 9), connected directly to the discharge flanges of the turbine. The injection water is taken from the intake tunnel which runs under the basement floor. The condenser injection water and

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air pumps are driven by a horizontal turbine. The air pump discharges into the intake canal, and the ejection pump discharges into a pipe leading to the spray cooling pond. Each condenser is capable of maintaining a vacuum of 28 in. when condensing 145,000 lb. of steam per hour with cooling water at 70 deg. Fahr. The exhaust steam from the turbines driving the condenser pumps is automatically admitted to the main turbines when the supply of exhaust steam is more than is required for feed water heating.

Intake Canal.

Water for all purposes, excepting drinking, is taken from the Bluestone River by way of an intake canal (Fig. 10). The canal is of reinforced concrete, and outside of the station has a section 10 ft. 8 in. by 10 ft.; under the condensers it widens out to 12 ft. 8 in. The total length of the canal is about 240 ft., half of which is inside the station.

At the intake are two rows of 5 ft. by 7 ft. screens, having structural steel frames and three kinds of mesh—a fine mesh, 4 by 4 of No. 12 gauge wire; medium mesh, 1 in. square of No. 10 gauge wire; and coarse mesh, made up of 2½ in. by ¼ in. flat bars spaced 2½ in. centres. The screens are removed for cleaning by means of a stationary derrick equipped with a hand-operated chain hoist.

Spray Cooling Pond.

The water from the circulating pumps of all condensers is discharged into the cooling pond. If the supply of river water is low, or not suitable for boiler use (it being very muddy at certain seasons) the water is sprayed into the pond and thence discharged into the intake canal. If there is sufficient cold river water of suitable quality, the water from the condensers is not sprayed, but is discharged into the pond, from which it is allowed to flow into the river reservoir several hundred feet below the intake, and circulates up stream to the intake, the complete circuit being about 1,400 ft. The cooling pond (Figs. 4 and 7) is situated to the north of the power station, close to the reservoir. It is 296 ft. long, 90 ft. wide, and 5 ft. deep. The basin is formed of a concrete retaining wall and an 8 in. bottom laid on rolled ground. The bottom consists of six inches of clay puddle covered by two inches of bithulitic covering. At the west end of the pond is a sluice gate opening into two 36 in. pipes, which discharge into the river some distance below the power station. As the normal level of the river is about 3 ft. below the bottom of the pond, the basin may be drained by the sluice gate should occasion require.

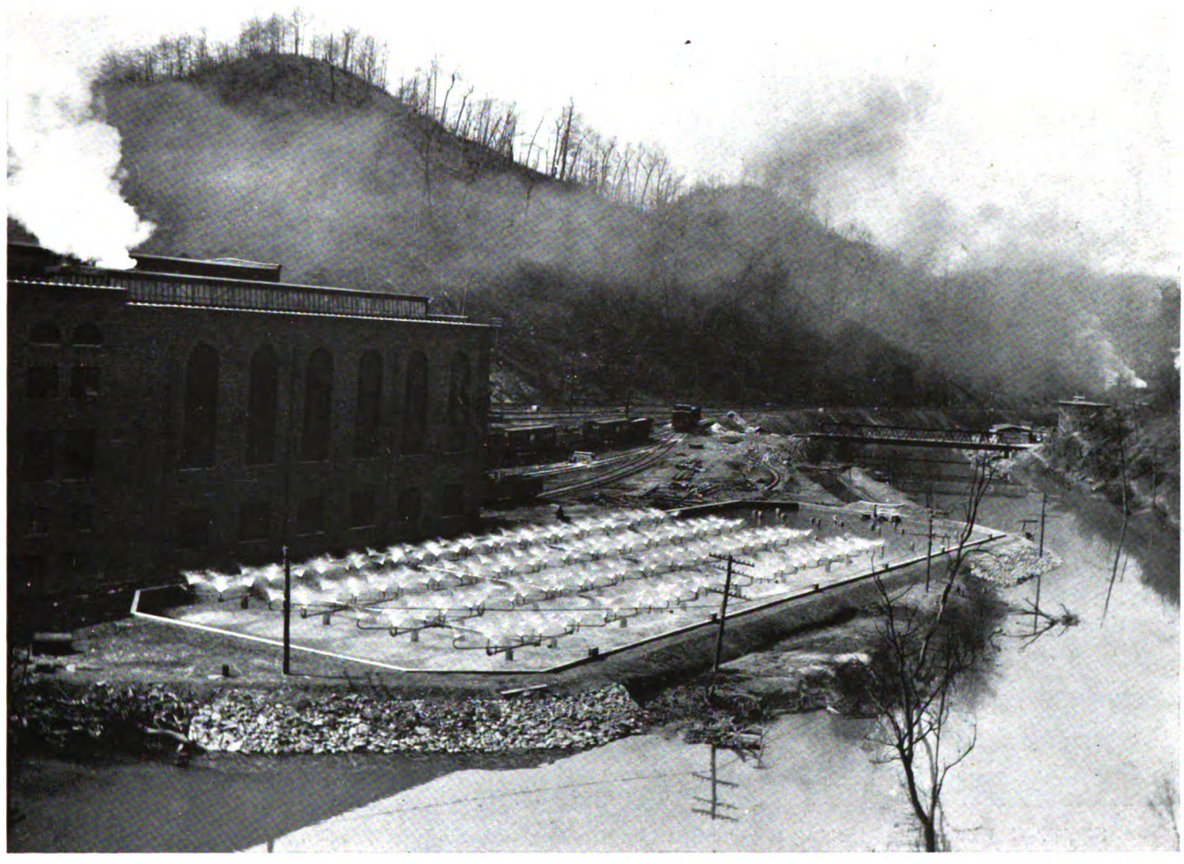

Fig. 7.—Spray Cooling Pond in Operation.

The spray nozzles and pond are fed by three 24 in. pipe lines from the power station. There are four rows of concrete piers supporting branch arms, each carrying three or four sets of spray brackets. Altogether there are 280 nozzles, with space provided for addition of 140. At the end of each of the four main branch lines is a bronze relief valve arranged to open automatically when the water pressure exceeds a predetermined value. The valves discharge downward on concrete slabs, which prevent the erosion of the basin bottom. With the exception of the 2½ in. wrought-iron spray brackets, all piping is of cast iron, painted inside and out with tar pitch varnish, conforming to the 1908 standard specifications of the

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American Waterworks Association. The nozzles are of U.S. Government specification bronze, and are each designed to discharge 62 gallons per minute with a nozzle pressure of 5 lb. per square inch.

At the south-east corner of the basin a 36 in. pipe fitted with a gate valve leads to the intake canal. The pond is capable of cooling 16,800 gallons per minute.

Piping.

The main steam header runs the entire length of the boiler room on the turbine room side. It is of 12 in. flanged steel pipe, and is fed by 8 in. lines from the boilers. Each boiler is equipped with an automatic non-return stop and check valve. For the sake of simplicity the gate valves on the feeders from the boilers are all located in the same relative position with respect to the main line. Each turbine is fed by a 12 in. line from the header.

Expansion is provided by making all bends of long radius. All straight lengths of main and auxiliary steam piping are of full weight wrought steel, with Van Stone extra heavy steel flanges, and all bends and offsets of main and auxiliary steam lines are of extra heavy steel, and all such piping is fitted with Van Stone extra heavy steel flanges. All exhaust steam piping up to 10 in. diameter is of merchant pipe, with standard weight screwed cast-iron flanges ; bends and offsets are of extra heavy pipe with standard weight cast-iron flanges. All exhaust lines of 12 in. diameter or over are of cast iron, with standard weight fittings.

The piping is covered with 85 per cent. magnesia blocks, 1½ in. in thickness. The smaller live steam pipes have one layer and the larger two layers. On fittings and valves where blocks could not be used plastic insulation has been applied of the same thickness as the blocks. The blocks are held on by wire, and covered with rosin-sized paper over which is sewn a covering of eight-ounce canvas. The exhaust and low pressure steam piping and fittings are covered with air cell sectional blocks of asbestos paper finished with rosin-sized paper and canvas, as in the case of live steam piping. The feed water piping between the boilers and heaters and the high pressure steam drip piping is covered the same as live steam piping. The canvas is painted a distinguishing colour, and stencilled with the name of the apparatus or piping.

Generators.

The main turbo-generators are of the Westinghouse type, having a rating of 10,000 K.W. at 80 per cent. power factor, 11,000 volts, 25 cycles, single phase. At this rating the generators are specified to run for twenty-four hours with a rise in temperature not exceeding 60 deg. Centigrade above the temperature of the cooling air. This temperature rating is used because the load factor and form of the load curve are such that a rating on this basis gives a truer conception of the size of plant required for the service than would be obtained by adhering to the usual temperature basis of rating machines operating on a high load factor. They are capable of delivering a single-phase output of 12,500 K.W. at 80 per cent. power factor for five minutes without injurious heating.

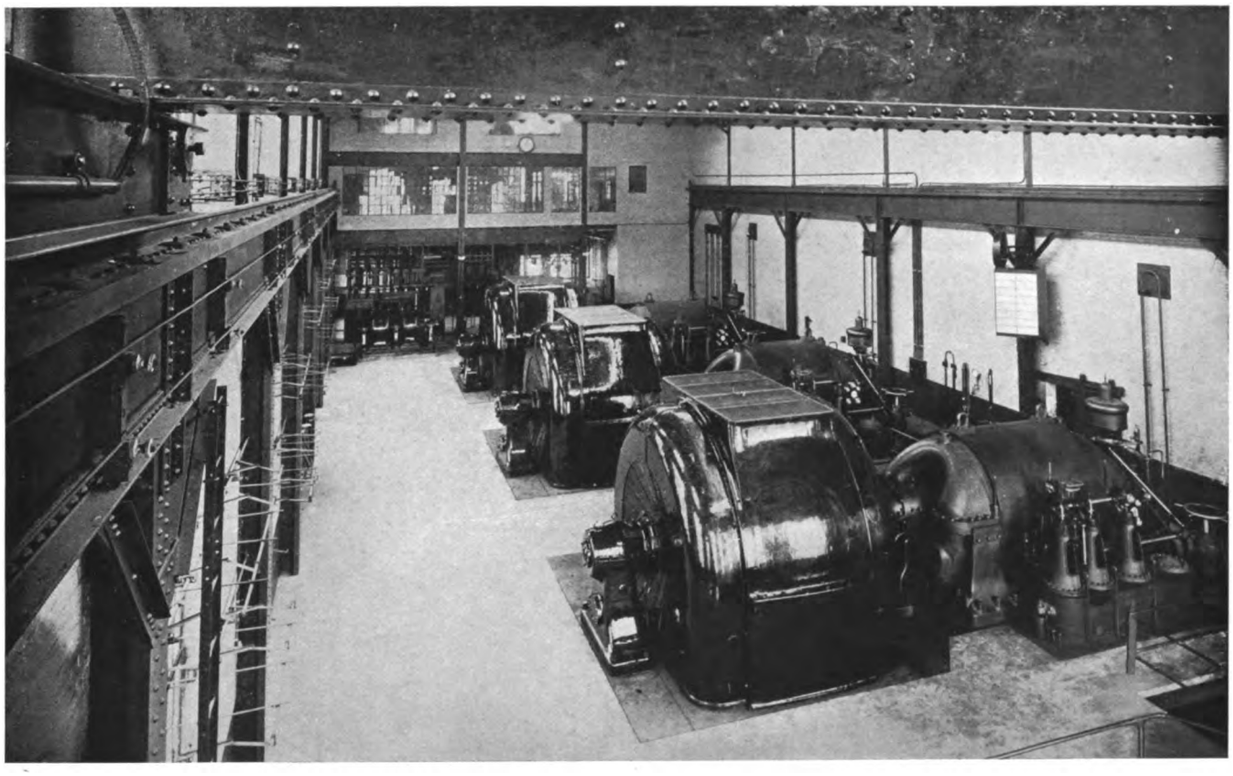

Fig. 8.—Turbine Room looking toward Operating Gallery with the Low Tension Switch Room below.

The field coils are of the two-pole type, wound with copper strap and insulated for a one minute potential of 1,000 V. A.C.; the insulation is capable of withstanding a temperature of 150 deg. C. without injury. Provision has been made for the insertion of plugs for balancing.

The armatures are wound for three-phase power, and are insulated for a one minute voltage test of 22,000 volts, and the insulation is capable of withstanding a temperature of 90 deg. Centigrade without injury. Thermo couples embedded in the armatures furnish a continuous temperature record.

Each generator is ventilated by a No. 6 Sirocco blower, having a capacity of 50,000 cubic feet of air per minute against a static head of 5 in. of water. Each fan is driven by a 100 H.P., 440 volt, 25 cycle, three-phase induction motor at 720 revolutions per minute.

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Although these motor-driven fans with the necessary transformers are on a mezzanine floor, they form an integral part of the generators to which they are electrically connected, and from which they take their power.

Excitation and Signal Generators.

There are two turbine-driven and one motor-driven exciter generators. The turbo-driven sets consist of small Westinghouse horizontal turbines rated at 150 K.W. The generators are compound-wound machines of the rotatory armature type, with commutating poles, and have a rating of 600 amperes at 250 volts when running at 2,200 revolutions per minute. The motor-driven set consists of a three-phase induction motor rated at 150 K.W. at 440 volts, 25 cycles, running at 720 revolutions per minute. The generator is a compound-wound machine of the 6-pole type, with a normal rating of 600 amperes at 250 volts. The motor takes

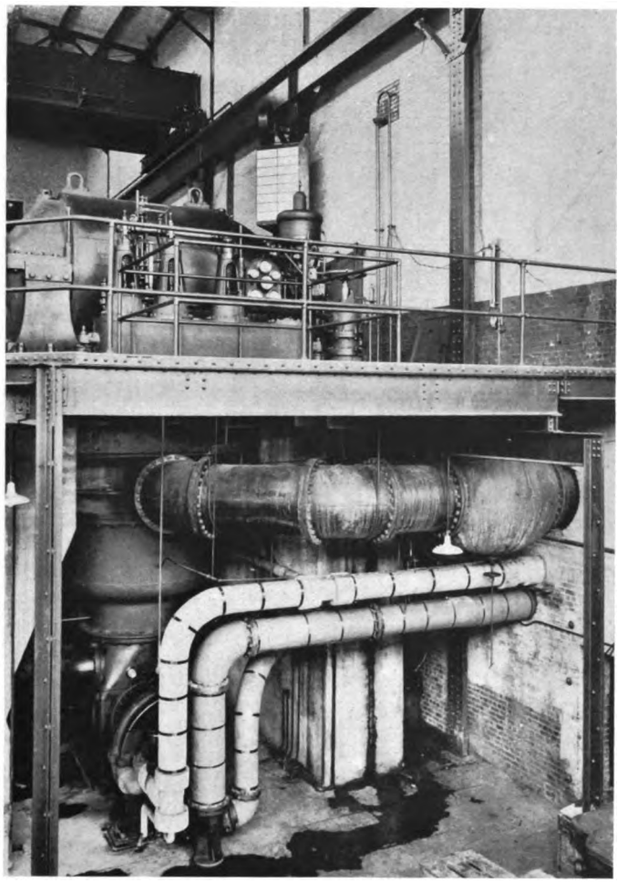

Fig. 9.—Le Blanc Condenser under one of the Turbines.

power from a three-phase self-cooled oil transformer rated at 200 K.V.A. A Tirrill regulator is used to vary the exciter voltage and current over sufficient range to insure practically constant voltage on all three main generators under all operating conditions.

Power for signal service in the electrified zone is supplied by two turbine-driven generators. Each set consists of a horizontal Westinghouse steam turbine direct connected to a 50 K.W., 4,400 volt, 60 cycle single-phase generator. These sets are placed in the turbine-room near the exciter generator.

Lubricating Oil System.

Oil is brought into the boiler-room in barrels, and emptied into a Bowser oil filter in the basement through a trap in the floor. The oil is pumped from the filter into the storage tank, having a capacity of 3,000 gallons, and placed about 32 ft. above the turbine floor. From the tank the oil flows by gravity to the turbine oiling system. This consists of a water-cooled reservoir from which the oil is pumped to the governor and the bearings by a pump operated from the turbine shaft by a worm-gear drive. The oil supplied to the governor is at a pressure of 45 lb. per square inch. This pressure is reduced to about 10 lb. per square inch by a reducing valve before passing to the bearings. After passing through the bearings the oil returns to the cooler reservoir. For starting up and for emergencies, an auxiliary oil pump for each turbine is placed in the basement. This takes oil from the cooler reservoir, and delivers it to a point just beyoud the turbine shaft pump. After the turbines are up to speed, the auxiliary pumps are cut out. All piping from pumps and storage to bearings is of brass; all return piping is of iron. The only oil cock is in the filter-room. This cock is locked, thereby preventing a large waste of oil by employees.

Switching Apparatus.

The main 11,000 volt bus bar is sectionalised, and three-phase power for auxiliary purposes is taken from the island section. No brick or concrete bus compartments are used, the bus being of copper tubing carried on insulators mounted on pipe framework. Copper tubing and bare wire is used wherever possible, insulated wire only where conductors are carried in conduits. The power supply to the 11,000 volt side of the three 5,000 K.V.A. step-up transformers is controlled by three 2-pole oil circuit breakers. The oil circuit breakers on the 11,000 volt circuits are solenoid operated, and are mounted on pipe framework. The leads from the oil circuit breakers are insulated; they run in conduits and on insulators to the transformers on the lower floor of the transformer house (Fig. 12). The high tension leads from the step-up transformers pass up through openings in the floor above to the oil circuit breakers and 44,000 volt bus bar. Copper tubing and bare wire are used in the bus work and wiring on this floor. The 44,000 volt bus bar is sectionalised, two high tension feeders being taken from each side. The high tension feeders and trolley feeders leave the building through openings in the south wall. The lightning arresters are located on the roof.

All oil circuit breakers are electrically controlled from the operating gallery (Fig. 11). Knife disconnecting switches are installed between busses and all oil circuit breakers, and on the line side of all high tension and trolley feeder circuit breakers. Electrolytic lightning arresters are connected to all feeders.

The signal feeder switchboard is on the operating-room floor, and the two 4,400 volt single-phase signal feeders are taken out through the east wall of the power house. The 4,400 volt oil circuit breakers are solenoid operated, and are made of boiler iron; no barriers are installed between any of the breakers. All oil circuit breakers are guaranteed to carry the currents due to overloads, short circuits, and grounds without injury. The insulation on the generator field leads and on all 11,000 and 4,400 volt cables is varnished cambric. The instrument and lighting wires are rubber insulated and are carried in iron conduits. The various sizes and kinds of insulated wire and cables used in the plant conform to the standard specifications of the American Institute of Electrical Engineers.

The electrically operated switching and control equipment receives power from the auxiliary D.C. bus or a storage battery which is in the north-east corner of the turbine-room basement. This set has a capacity of 160 ampere hours at 220 volts, and is charged by a 5 K.W. motor generator set in the operating gallery.

All switching apparatus is controlled from the operating gallery. The switchboards consist of a generator bench, main power board, auxiliary power

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board, and a signal power board. The panels on these boards are all of oil-finished natural black slate, and all metal fittings and instruments have a dull black finish. All instruments are of the round pattern, and have black faces with white scales and needle points. The arrangement of apparatus and instruments on the panels are shown in Fig. 11.

Regeneration Loading Rheostats.

Excess regenerated power returned to the power house at no load passes to the 11,000 volt bus and through the various transformers back to the generators, if the generators are running under very light load or no load. If no other load were provided, the regenerated power would reverse the generators and operate them as motors. To prevent this a loading device consisting of electrodes immersed in the intake canal and controlled by suitable switches is provided.

The operation of the switches is made automatic by means of a group of relays and magnetic switches, current transformers, etc., so connected as to give the following results:— When the amount of excess regenerated power reaches, say, 300 K.V.A., the closing relays throw in one water rheostat on the 11,000 V. bus. As soon as the regenerated power exceeds the capacity of one water rheostat by 300 K.V.A. another closing

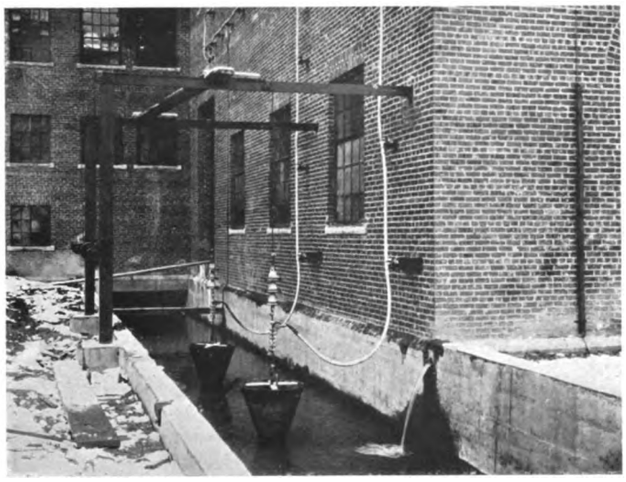

Fig. 10.—Regenerated Power Loading Rheostats.
(The Rheostats are placed in the Intake Canal, and the view shows provision for raising and lowering Cones in the water.)

relay throws the second water rheostat in on the 11,000 V. bus. The difference between the amount of excess regenerated power and the capacity of the water rheostats in service is made up by the generators. When the excess regenerated power has become reduced to zero with one rheostat in service, all of the rheostat load being supplied by the generators, one of the tripping relays trips the circuit breakers, which cuts the rheostat off the 11,000 volt bus. With two rheostats in service, when the excess regenerated power drops to 2,000 K.V.A., one of the relays opens the breaker, which was closed first, and cuts one rheostat out of service. The other rheostat remains in until the excess regenerated power drops to zero, when it too is cut out of service.

The water rheostats (Fig. 10) are situated outside of the transformer house at the Bluestone station (Fig. 1). Each rheostat consists of a steel cone carrying a lead from the circuit breakers, and a fixed ingot iron plate placed at the bottom of the intake canal, and grounded to a copper plate bedded in the earth outside of the canal. The power dissipating capacity is adjusted by varying the distance between the cone and the iron plate. The cone is raised or lowered in the canal by means of a hand-operated winch and cable carried on a steel bracket across the canal.

Compressed Air Supply.

Compressed air is supplied for operating tools in the locomotive repair shop, for cleaning generators, and for general use about the plant. The compressor is placed in the boiler-room basement, near the low head pumps. It is of the steam-driven type, having 14 in. by 14 in. steam and air cylinders, and has a capacity of 412 cubic feet of free air per minute at 165 revolutions per minute, maintaining a pressure of about 100 lb. per square inch. It is equipped with an automatic speed and pressure regulating governor and unloading device. The valves are of the balanced type, with Meyer adjustable cut-off. This equipment was supplied by the Chicago Pneumatic Tool Company, of New York.

Lighting and Heating.

The lighting circuit may be supplied with either 220 volts A.C. or 250 volts D.C. Power is taken from the 200 K.V.A. three-phase transformer, or from the A.C. auxiliary power bus. All main lighting is by single 150-250 watt Tungsten lamps, detail lighting by 25-100 watt lamps. In addition to the permanent fixtures, numerous wall sockets have been provided. Wherever equipment is placed on the roof, suitable permanent lighting fixtures have been provided. The heating system is supplied from the exhaust steam header. Altogether over 5,000 square feet of heating surface are distributed about the power house and inspection building.

Drinking Water.

An artesian well in the power house supplies drinking water for all employees at the power station as well as for the inspection building and employees' dwellings. The water is raised by means of an air lift to a storage tank, from which it is supplied to the circulating pipe at about 40 lb. pressure by a small duplex pump of about 10 gallons per minute capacity. The pumps are in duplicate. Direct current at 250 volts used for operating the crane, elevator, etc., is taken from the D.C. auxiliary power bus.

Turbine-Room Signals.

A complete signal communicating system has been installed. A monitor board is installed on the south wall of the turbine room. Symbols governing the operation of the main generators, exciters, and signal generators are painted on ground glass and are illuminated by the operation of push-button switches in the operating gallery. Return signal lamps are also provided on the main power board in the operating gallery. Pneumatic whistles are provided in the boiler room, pump room, and turbine-room, as well as the indicating signals at each main turbo-unit.

Transmission.

High tension power is transmitted at 44,000 volts, 25 cycles, single-phase. The wires are carried on the catenary supports, except at the tunnels, where the line goes above ground over the summits. The method of support is clearly shown in Figs. 18 and 19. As can be seen in the illustrations, there are two single-phase lines. These consist of four No. 2/0-seven-strand hard-drawn copper wires. A $\frac{3}{8}$ in. steel ground wire is carried on the poles for the length of the line. The high tension insulators are of the four-petticoat pin type, with a maximum diameter of 12 in., and are tested at 165,000 and 120,000 volts respectively, for dry and wet flashover; their ultimate mechanical strength is about 4,000 lb. applied at right angles to the pin at the wire groove.

The wood poles of the lines over the tunnel summits are of chestnut, and vary from 45 ft. to 55 ft. in length. At present they carry three arms, each with provision for a fourth. The arms are 4 in. by 4 in. by $\frac{5}{16}$ in.

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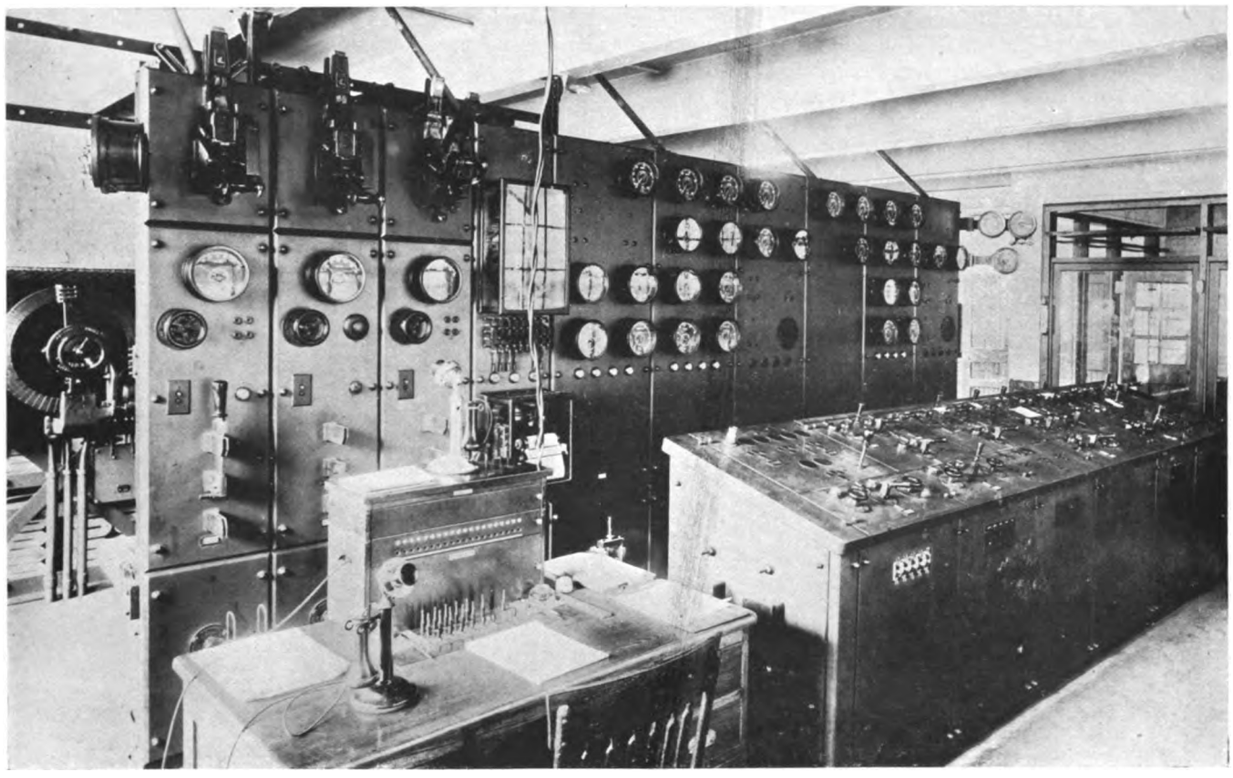

Fig. 11.—Control Boards in the Operating Gallery, from which all Switching Apparatus is Controlled.

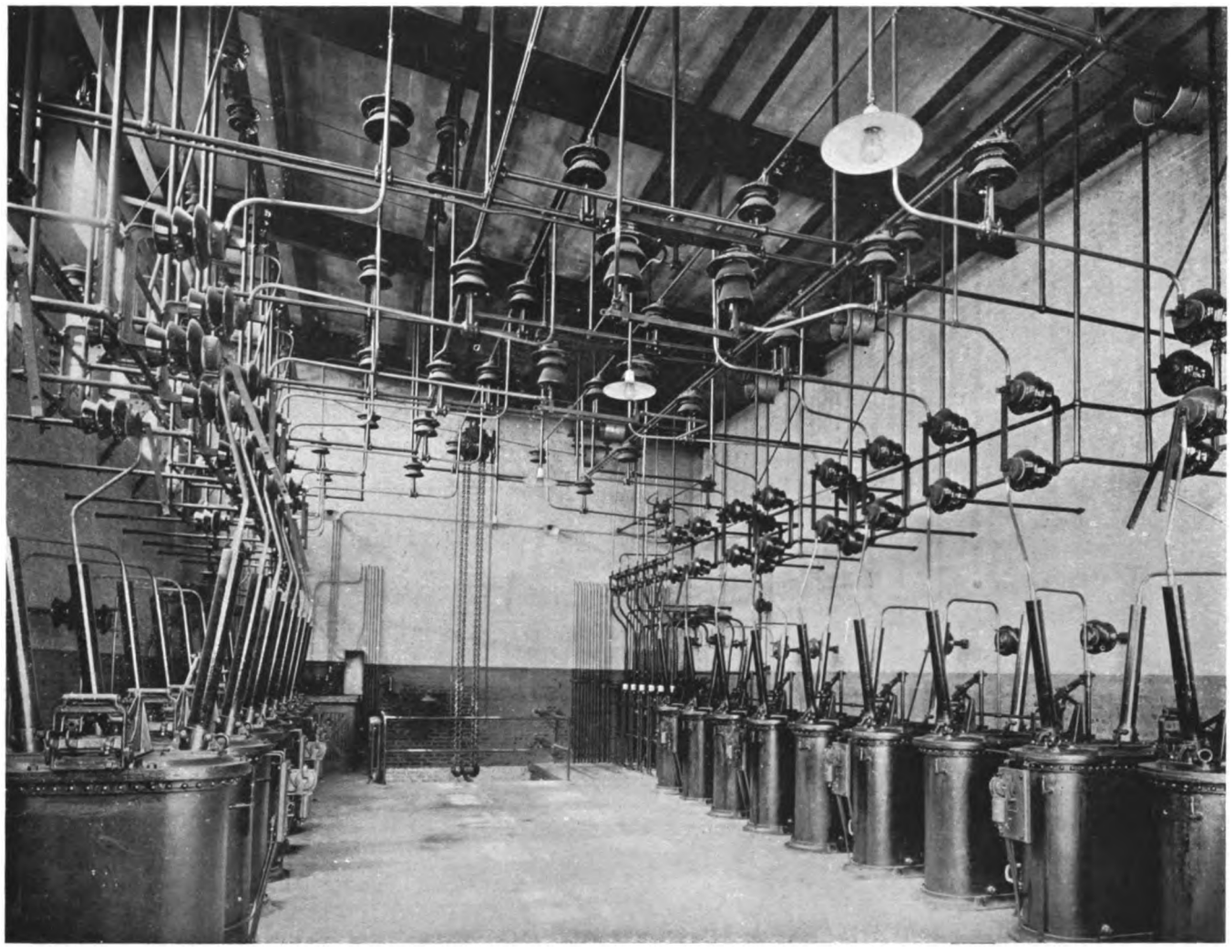

Fig. 12.—Interior of High-tension Switch Room showing Oil Circuit Breakers on Right, Transformers on Left.
(No brick partitions are used. Heavy pipe bus-bars are supported from pipe frame-work.)

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angles, and are braced by 2½ in. by 2½ in. by ¼ in. angles. Each arm carries two wires. The two upper cross arms carry the 44,000 volt wires, and the lower arms the 4,400 volt signal wires. An 11,000 volt trolley feeder is carried over the Elkhorn Tunnel summit.

The cross arms on all poles are connected to the ground wire, which is grounded by means of a copper cable, which terminates in a copper plate bedded in the earth at the base of every fourth pole. The high tension lines are sectionalised at each sub-station by means of air-break switches on steel structures on the roof.

Sub-stations.

All power supplied to the trolley system and trains is obtained from transformers which step down the voltage from 44,000 to 11,000 volts. These are placed at suitable points along the line, and are housed in suitable buildings, except at West Vivian, where the apparatus is of the outdoor type and unhoused. The primary reason for the outdoor type of sub-station at West Vivian is that the desirable and proper place for this sub-station when electrification is extended would be several miles west of the present location, and therefore the present location is considered as only temporary. One of the sub-stations is located in the transformer and switching house at the power station. On account of objectionable conditions which would result from short circuits it was decided not to feed the nearby sections of trolley lines directly from the power-house generator bus. Fig. 13 shows the general connections with the principal sub-station apparatus.

The buildings are all of the same type, and are similar to the Maybuery Station illustrated in Fig. 14, which shows the exterior of the sub-station. The oil circuit breakers (Fig. 15) in the sub-stations are remote-controlled, and will be operated from adjacent signal towers or passenger stations, or yard masters' offices, thus requiring no attendance. Power at 440 volts for the operation of oil circuit breakers is obtained from two step-down transformers, one connected to the 11,000 volt bus and one to the 44,000 volt bus.

The equipment of sub-stations is as follows :—

Bluefield ...	... 2-3,000 K.V.A. Units ...	6,000 K.V.A.
Bluestone (Power House) ...	... 2-2,000 K.V.A. Units ...	4,000 K.V.A.
Maybeury	... 2-5,000 K.V.A. Units ...	10 000 K.V.A.
North Fork	... 2-3,000 K.V.A. Units ...	6,000 K.V.A
Vivian ...	... 1-2,000 K.V.A. Units ...	2,000 K.V.A.
	Total capacity	28,000 K.V.A.

The transformers are of the Westinghouse single-phase, oil-insulated, water-cooled type, with primaries wound for 44,000 volts and secondaries for 11,000 volts. Water for cooling is taken from the company's pipe line. The transformers are carried on separate trucks, having a 4 ft. 3 in. gauge. They are equipped with thermo-state, which at high temperatures close a bell alarm circuit to the nearest operator's office. Two transformer oil filter outfits have been provided—one for the power house and one for the sub-stations. The latter outfit is transferred from one sub-station to another as required. Each equipment consists of a filter press, drying oven, and motor-driven centrifugal oil pump ; each has a capacity of 7 to 10 gallons per minute. A 16-ton chain hoist for lifting the cores out of the transformer cases is provided in each sub-station. The switching equipment and the panels in the sub-stations are of the same type as in the power house.

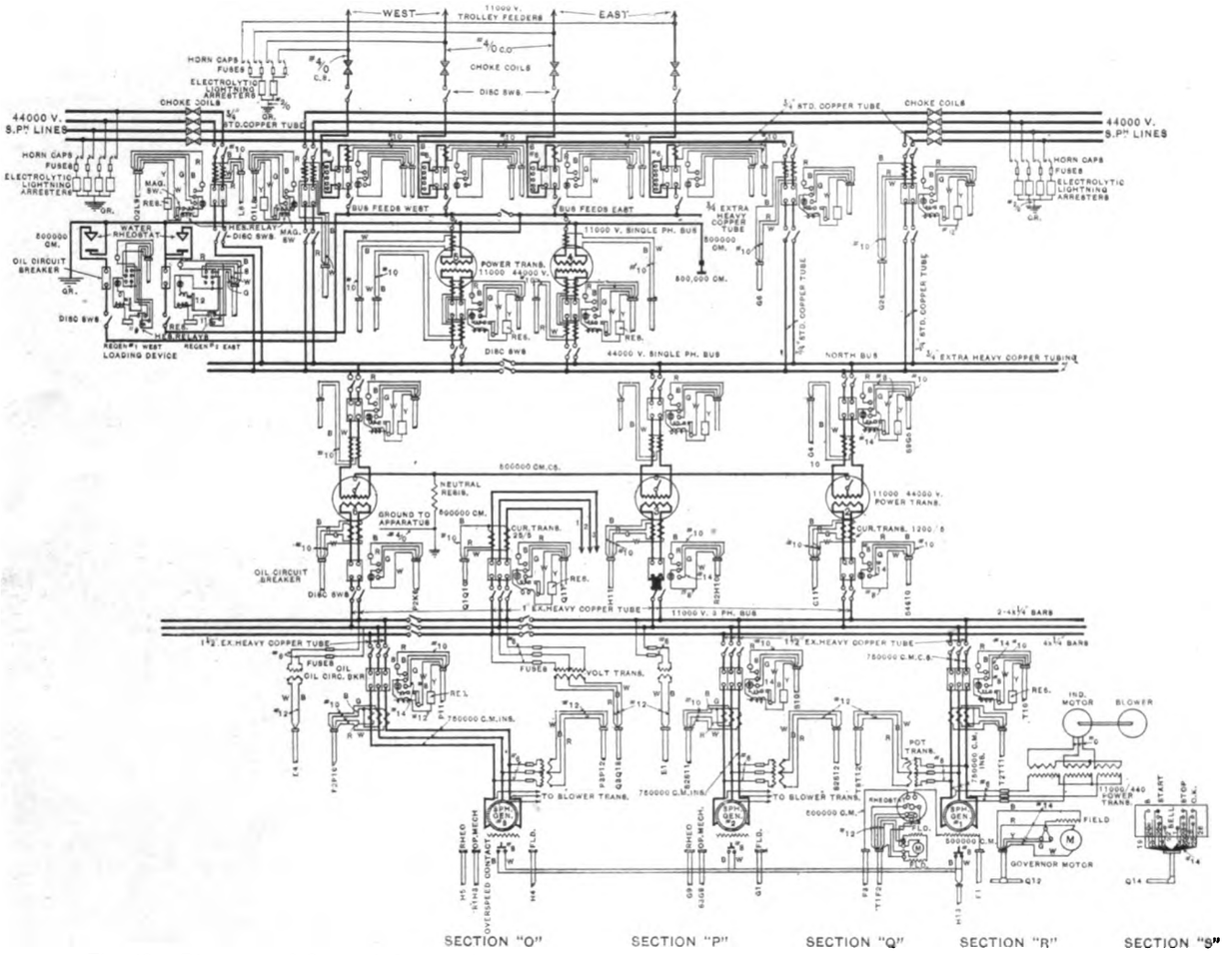

Fig. 13.—Diagram of General Connections between Power Station and Principal Sub-Station Apparatus.

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Fig. 14.—Exterior of Maybuery Sub-station—a Typical Structure.

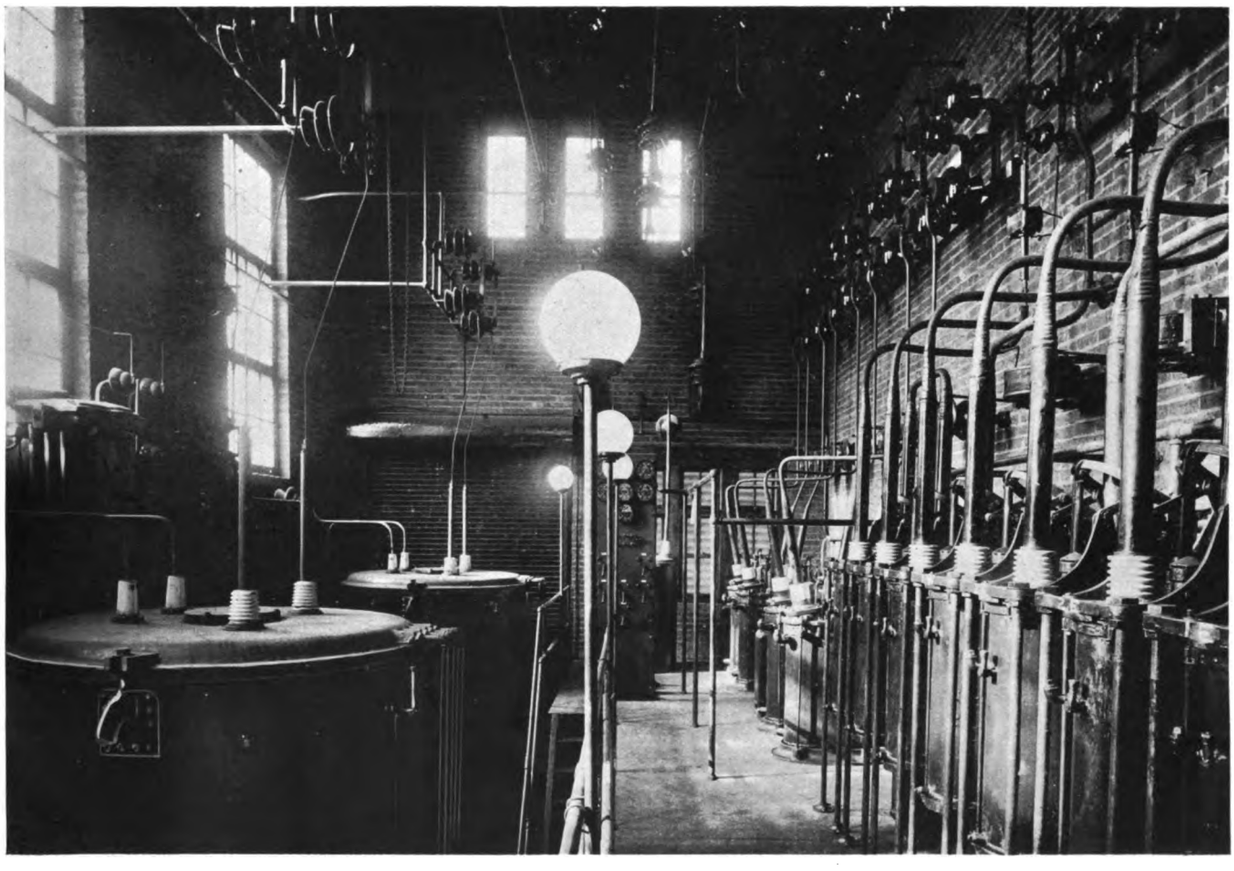

Fig. 15.—Interior of Maybuery Sub-station—Circuit Breakers on the Right

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DISTRIBUTION AND CATENARY CONSTRUCTION.

One advantage of using a very high voltage on the contact system is that no supplementary feeders are required, the distribution of power from sub-stations being effected entirely by means of the trolley lines proper. There are two distinct types of structures used for supporting the system of catenary or trolley lines; one, which is used on the main line, where the wires are suspended from overhead beams or girders (Figs. 16 and 17), and the other, used in yards, where an overhead cross-catenary cable is used to support the longitudinal catenary wires of several tracks.

Fig. 17 shows a typical main line structure. It consists of two tubular steel poles set in concrete foundations and carrying between them a structural H-beam, the beam being partially supported by means of rod braces up to the poles. The poles extend above the cross-beam and rod braces, and support cross-arms which carry the high tension feeders and the signal feeders. The protecting ground wires are clamped to castings screwed on the top of the poles. The structure as a whole is unguyed if on straight track, but on curved track it is guyed on the outside of the curve, that is, guyed against the curve pull of the catenary system. This type of structure has proved satisfactory wherever there is room on the right of way for guying. It is simple in design, can be readily arranged to give any desired horizontal or vertical clearance, is easy to erect, and the use of sag braces instead of knee braces gives the desired clearance under the beam for the wires, while not adding to the height of the poles, since they must be extended to carry the high tension and signal feeders. On long stretches of straight track, the cross-beams might interfere somewhat with a clear view of the signals, but in the present case there is but little tangent track and no long stretches of it, so there is no noticeable interference with the view of the signals.

Catenary supporting structures are nominally 300 ft. apart on straight track and somewhat closer together on curves, depending on the degree of curvature, and whether or not intermediate pull-off poles are used between adjacent supporting structures. The foundations are of 1 : 2 : 5 concrete, reinforced with rods, and cored with a collapsible form, a copper ground plate being set in coke underneath one of the two foundations, and a substantial copper cable carried up through the concrete for later attachment to the pole with an expanded pin type bond terminal.

The steel poles are built up of various lengths, sizes, and weights of steel pipe wedged together. A reinforcing collar of ½ in. plate protects the pole at and above the top of the foundation. The poles change in size at the height of the cross-beams, thus making a shoulder on which sit the heavy steel castings holding the cross-beam and to which castings are also attached the guy rods when these are used. The poles are unloaded and up-ended into the cored holes in the foundations by means of a derrick car, and after the beam is erected and the whole structure lined up they are grouted into place.

The guys are of very substantial construction, and are relied upon to carry a material portion of the load. Patented guy anchors, after trial, were abandoned in favour of concrete slabs containing two or more pieces of old rail, the slab being of such size and depth that its weight and the dead weight of earth above is safely more than the maximum pull on the guys. The guys are generally round steel rods made in three pieces, the ground or anchor end being protected where it passes through the earth by boiler tube having the annular space between tube and rod filled with grout. The upper ends of the rods are of uniform length, while the closing or middle piece is cut on the ground to the proper length, and final adjustment is made by means of turn-buckles. Double guys are used, the two rods making an angle of 20 degrees with the pole, and are spread at the anchor ends, so the two rods make an angle of about 40 degrees with each other.

While the above describes the normal main line structure, there are many variations, including bridges having both structural posts and girders which are used where the structures carry signals as well as the catenary system. Similar though lighter structural bridges are used on curved track where property for guy anchors is not available. Structural bridges guyed longitudinally with the track are also used where it is desired to anchor or dead-end the catenary system. Fig. 22 shows a typical combined signal and catenary carrying bridge. In the yards the catenary-carrying structures consist of two or more high steel posts or columns, guyed or self-supporting depending on location and available property. These posts are supported on concrete foundations, which, when no guys are used, are spread out and reinforced to take the large overturning moments involved in this type of construction.

From the top of one post a cross-catenary cable of extra high tension galvanised steel strand is run across the tracks to the top of the opposite post. In many instances this is 1½ in. cable, having a breaking strength of about 240,000 lb. It is designed to have a large sag, which, where the yard is several tracks wide, necessitates high posts. A second strand of steel cable is carried horizontally from post to post, below and suspended from the top cross-catenary cable with ¾ in. rods. These rods, which are attached to the two cables forming the wire bridge by means of special malleable iron attachments, are so placed that they come at those points on the lower wire where it is necessary to attach the longitudinal catenary system.

All cables are held by heavy forged sockets, adjusted by means of turn-buckles, and held at the posts by connection plates designed as a part of the structure. In general all cross-catenary materials are double galvanised. On the high yard posts the guys, which in some cases are designed for working loads as high as 80,000 lb., are of steel cable; though here, too, as in the main line work, the anchors are of the dead weight reinforced concrete slab type. Fig. 18, showing a view in the Flat Top Yard, is typical of this yard type of construction. The steel structures, other than tubular poles, were manufactured by the Virginia Bridge Company.

THE CATENARY SYSTEM.

The appearance of the catenary system is so simple that one has actually to build it before appreciating the many problems and difficulties that surround its design and construction. The object in the present case is to hold a 3/0 grooved phono-electric contact or trolley wire at a uniform height of 24 ft. above the top of the rails in such a location that it will not vary horizontally more than 12 in. from the centre of the rails (allowing for super-elevation), and that the bottom of the wire will present an unbroken level surface on which the pantagraph shoe will ride smoothly. Problems commence to develop when one realises that with a wire structure supported only every 200 to 300 ft. the temperature ranging from 110 deg. to —10 deg. will change the stresses from almost zero to close to the elastic limit, that wind and sleet loads must be reckoned with, that the system must be insulated for a potential of 11,000 volts to ground under all atmospheric conditions, and that the wires over one track must be insulated from the wires over all other tracks.

Over straight tracks the construction is simple. From each of the supporting structures a steel casting

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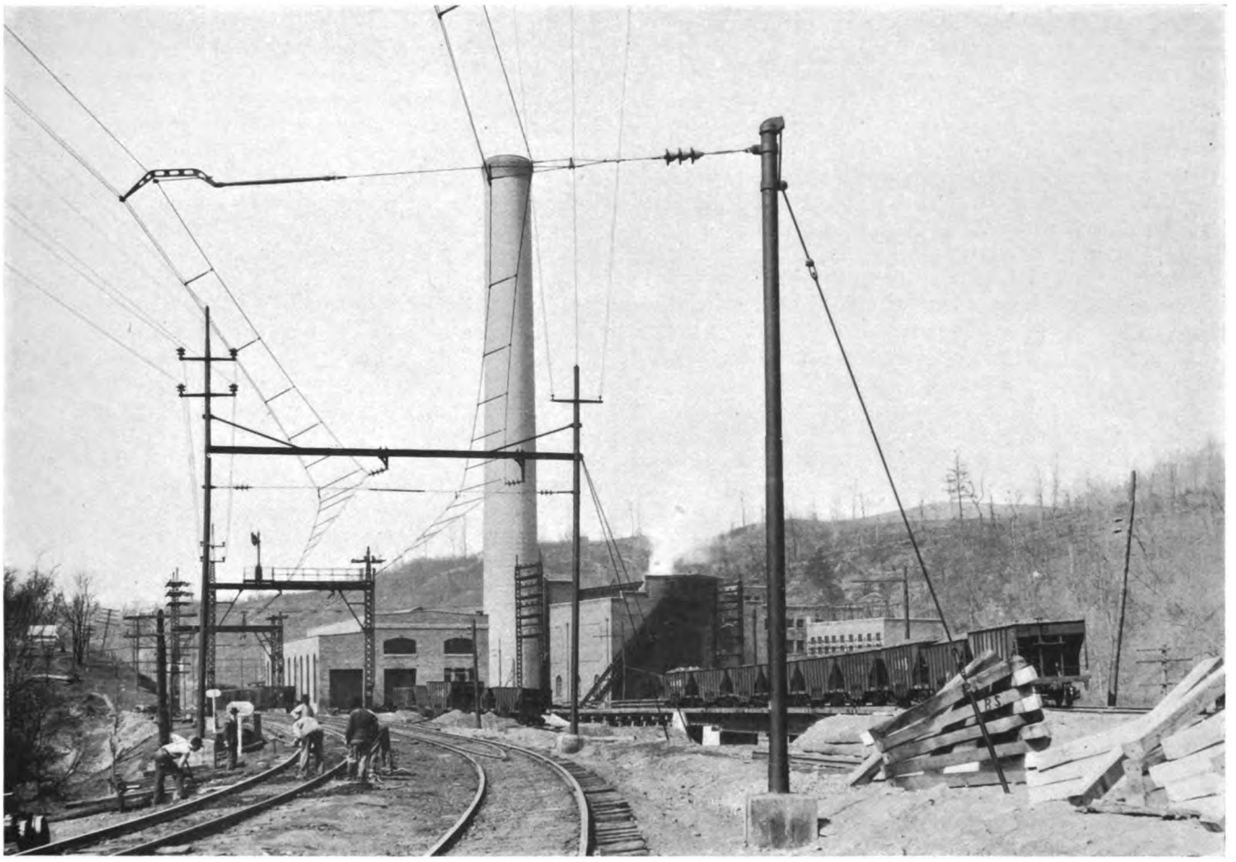

Fig. 16.—Catenary Suspension, showing Typical Pull-off Pole in Foreground, and Construction required on very sharp Curves.
(The Power Station is seen in the background.)

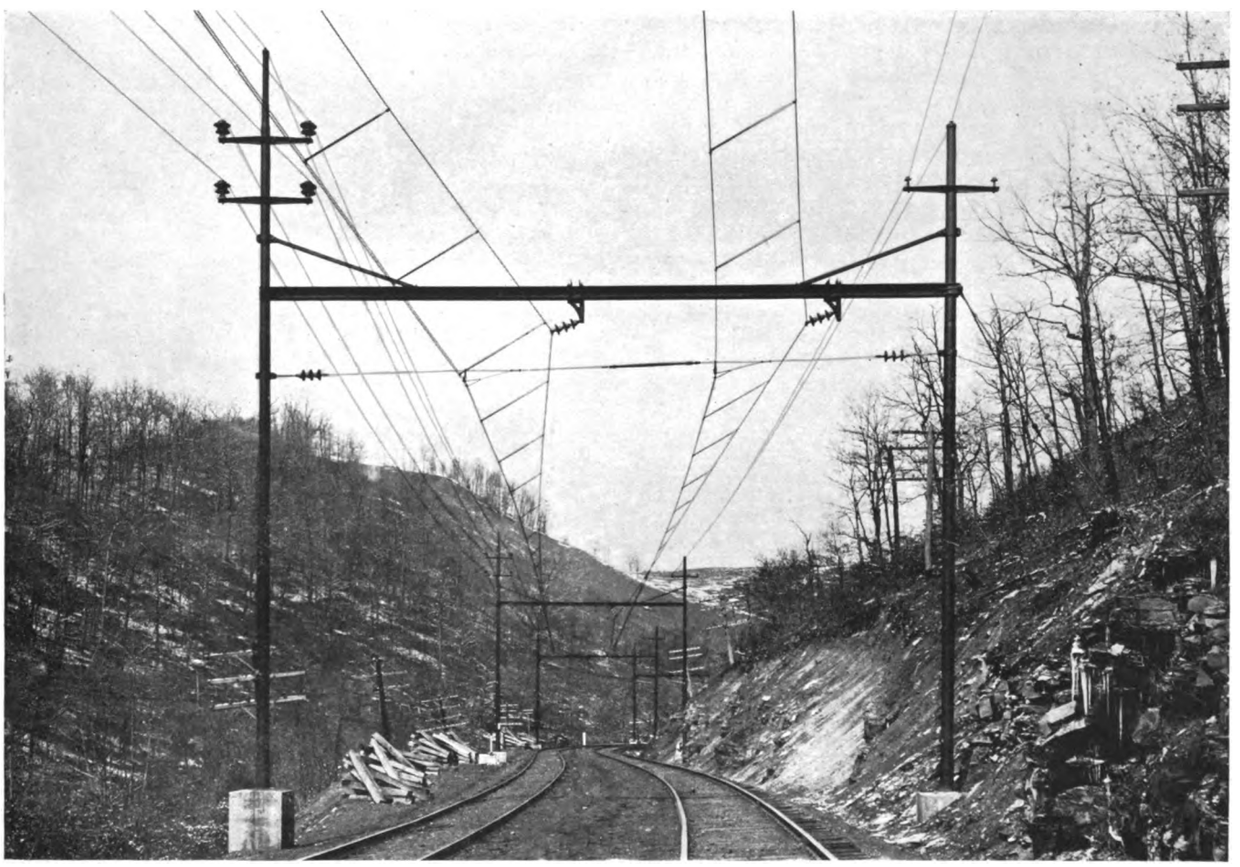

Fig. 17.—Typical Curve on Main Line at Tangent Point.

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attached to the horizontal beam or girder serves as a support for three suspension type insulators. Each of these three insulators is of itself good for a working voltage of 11,000 volts, and three are used as a special insurance against line troubles. These porcelain insulators are 8 in. in diameter, a little over 5 in. long, and have an ultimate strength of 12,000 lb. Since the initial energising of the line about the middle of December there has not been a single failure of any of these strings of insulators. To the bottom insulator is attached a malleable iron casting which supports and clamps the messenger wire. This casting has ample bearing for the wire, and also has arcing horns, so that should an insulator fail the arc will probably be from the casting instead of from the wire.

The messenger wire is ½ in. extra high tension galvanised steel stranded cable, having a breaking strength of over 30,000 lb. It is jointed by forged sockets which were specially designed to develop the full strength of the cable. The nominal sag in the messenger wire is 5 ft. in a 300 ft. span, the actual sag, of course, depending upon the particular span. Spaced 30 ft. apart along the messenger wire are bent strap clips which hold the hanger straps. These rectangular hanger straps are of galvanised steel, and they are all of different lengths, depending on their distance from the low point of the messenger wire, the length of each hanger being calculated so that the bottom of all hangers will be the same distance above top of rail. To the bottom of the hangers is bolted a pair of malleable iron trolley clips, which, however, on straight track do not grip the contact or trolley wire, but hold an auxiliary messenger wire. This auxiliary messenger wire is a No. O round copper or steel wire, depending on whether the load conditions require the added carrying capacity of copper over steel. From the auxiliary messenger wire the 3/0 grooved contact or trolley wire is supported by a pair of clips bolted together and spaced 15 ft. apart, but so spaced that they are equi-distant from the hangers holding up the auxiliary messenger wire. The result is an extremely flexible or "smooth" running trolley.

All calculations are made for an average temperature of 60 deg. As the temperature lowers, the tension in all wires increases, and the contact wire rises somewhat in the centre of the span, but even a 6 in. rise in a 300 ft. span makes a trolley gradient of only 1½ of 1 per cent., whereas gradients of ¼ of 1 per cent. are permissible. As the temperature rises above 60 deg. all tensions decrease, and the contact wire sags uniformly toward the centre of the span with a maximum sag of a few inches. Steady strands hold the trolley wires in place crosswise to the tracks, where this is found necessary in the longer straight stretches. All such steady strands are insulated from ground by a string of three suspension type insulators. Where one of these cross-steady-strands from pole to pole of structure attaches to the wires over two or more tracks, it is sectionalised between tracks by an impregnated wood stick insulator 4 ft. long. These wood stick insulators are all tested to 8,000 lb., which is largely in excess of the maximum load where they are used.

The trolley is sectionalised longitudinally where necessary by breaking the messenger wire with two strings in parallel of three insulators each. Directly below this electrical break in the messenger wire the auxiliary messenger and contact wires are attached with turn-buckles to the ends of a heavy impregnated wood stick insulator. Tee iron runners are supported from the trolley wires and from the wood stick insulator. The runners, being supported at opposite ends and sides of the insulators, have ample electrical clearance from each other, but being at the same elevation and overlapping longitudinally, the pantagraph makes contact with the second before leaving the first, so that while the catenary system is sectionalised there is no interruption to current supply to the locomotives in passing. At those section breaks which are provided to permit isolation of parts of the line for repairs, but which are normally electrically connected, specially designed disconnecting knife switches are mounted on top of the wooden section break insulators. These can be opened or closed from the ground by a long impregnated wooden switch stick.

In some places the catenary system is anchored longitudinally or dead-ended by being solidly attached to the cross girders of special structural bridges provided for that purpose; in such cases, of course, the messenger is insulated from the bridge by the double string of three insulators. Such anchors are to limit the zone of trouble should a wreck or other unforeseen accident break a messenger wire. The normal messenger wire support at the bottom of the strings of insulators is so designed that at a certain pull the messenger will slip through. Hence, should a messenger break between anchors, it is expected it will slip through several supports adjacent to the break, and thus distribute the abnormal strain over several bridges instead of the strain coming all on the two structures at each side of the break. The above, while particularly describing main line straight track construction, applies in large measure to the whole of the catenary system.

Where the track is curved, as it is in the great portion of the work, the trolley or contact wire must also be curved, so that it approximates the track curvature. The system has been designed within limits such that the contact wire may be 12 in. off the centre line of track in one direction at the bridges or points of support, and 6 in. off the centre line of track in the other direction at the centre of the span. This allows the trolley curvature to be less than the track curvature, the middle ordinate of the trolley curve in a given span being 18 in. less than the middle ordinate of the track curve, provided full advantage has been taken of the permissible limits of trolley departure. In speaking of centre of track and departure of trolley wire, therefore, what is really meant is the *loci* of the middle point on the pantagraph shoe, which, of course, is not vertically above the centre of the track if there is any super-elevation to the rails, and which super-elevation must be taken into careful account before any calculation is done. On curved track the catenary system (that is, messenger wire, hangers, and trolley wires), instead of lying in a vertical plane as over-tangent track, lies in an inclined plane, which is warped until the trolley curvature approaches the track curvature.

The suspension insulators, instead of hanging vertically, respond to the curve pull of the system, and hang at a definite angle, depending upon the curvature of the system. The hangers on curves are 15 ft. apart, and the clips at the bottom hold both the auxiliary messenger and the contact or trolley wire. This is essential, since unless held vertically below the auxiliary messenger by resistance to bending in the clips and the hangers, the curve pull of the contact wire would pull it up to the same level as the auxiliary messenger. This holding of both wires by the same clips at the ends of the hangers does not, however, result in "hard spots" in the trolley, since all hangers lie at an angle to the horizontal, and the whole system is sufficiently free to move vertically, under the slight upward pressure of the pantagraph, to insure smooth riding. In this district most of the track is curved, and a large portion of it is a relatively high degree of curvature running to a maximum of 12 degrees.

The amount of trolley curvature that can be obtained with a fixed distance between points of support, that is,

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for a definite span, is limited by the practical length of hangers and by the amount the point of attachment of insulators on the bridge can be offset from the centre line of the track. In order to avoid an uneconomically close spacing of structures on the high track curves, one, and sometimes two, pull-off poles are used between bridges. These pull-off poles are single tubular steel poles set in concrete foundations, and having single guys of the same type as used on the catenary bridges. A wire strand from the top of these poles, and insulated from it by three of the suspension type insulators, is fastened to both messenger and contact wire, and serves to bend the plane of the catenary system. Fig. 16 shows a typical pull-off pole for two track main line condition. The use of these pull-off poles and a similar pulling off or bending the plane of the catenary by means of pull-off strands at the bridges permits a much greater distance between points of support than would be the case if the contact wire had a uniform curvature, and was not thus bent in a horizontal direction.

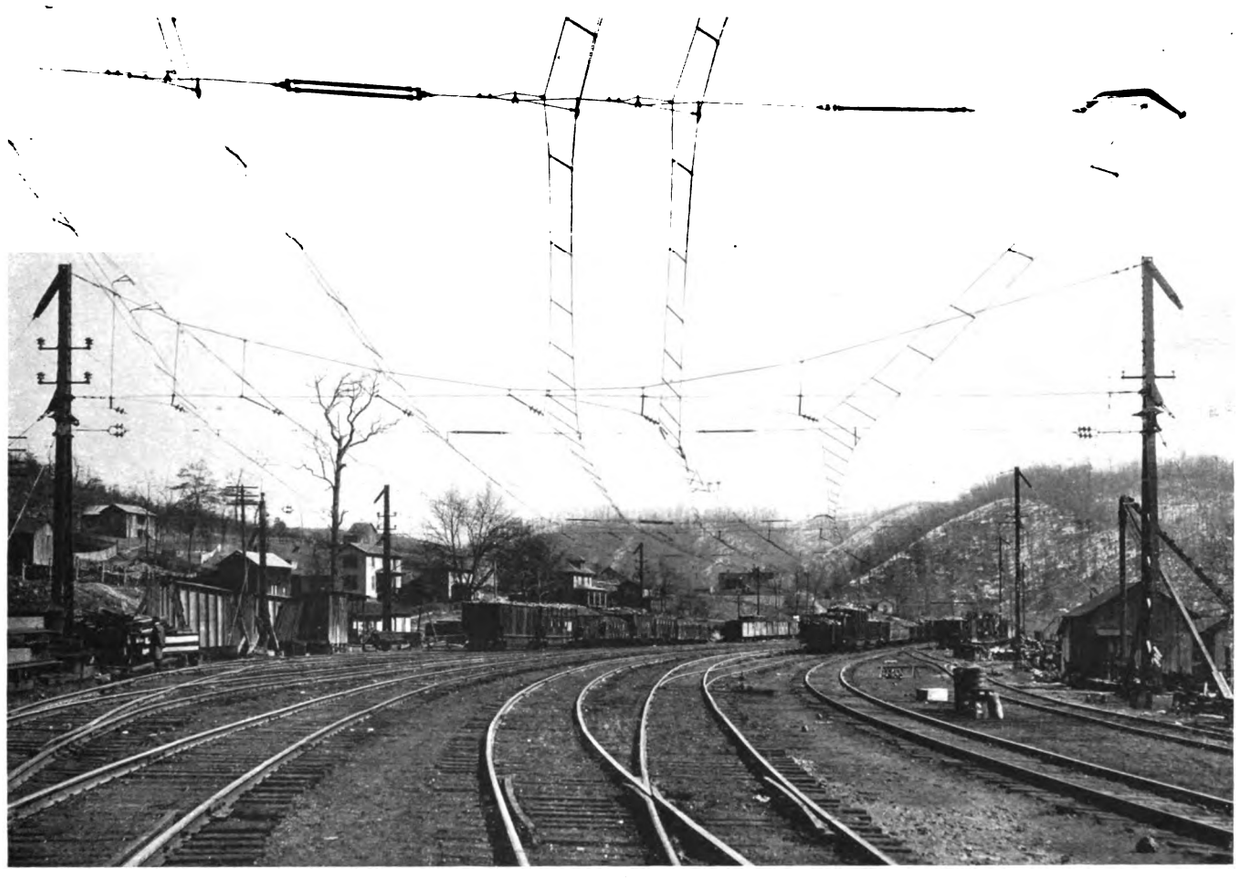

Fig. 18.—Typical Cross-catenary Construction in Flat Top Yard

Several of the photographs referred to elsewhere show various forms of the catenary construction, and Fig. 17 gives a fair view of a transition point, that is, where the track, and hence the catenary, changes from a curve to a straight; when completed, such a transition point in the catenary system looks simple and even graceful, but those who think it easy to predetermine the length of each individual hanger, as was done throughout this work, are not to be found among those who did it.

In the Elkhorn Tunnel special catenary construction was necessary. This is a single-track tunnel, 3,000 ft. long, the walls are 14 ft. apart at the springing and 13 ft. apart at the base; the springing is 11 ft. 1 in. above top of rails, while the crown of the arch is 19 ft. 3 in. high. Extended experiments in insulators and their arrangement were made in a sample metal-lined tunnel, where high voltages were submitted to the smoke and steam from a locomotive. The arrangement adopted was to have a supporting structure every 75 ft. apart. At each side of each structure two cast-iron brackets, held to the brick lining of the tunnel by large bronze expansion bolts, each carry a 44,000 volt transmission line insulator. A 2 in. brass pipe is carried parallel to the tracks by the pair of insulators on each side. Another line insulator on each side is mounted by bronze castings at the middle of these pipes, and a cross-pipe bent to follow the arch of the tunnel forms the support for a bronze messenger wire. The live catenary parts have therefore double 44,000 volt insulation to ground. Despite the necessarily very limited clearances, the work in this tunnel stood a test of three times normal trolley voltage, and has so far answered very satisfactorily for the several weeks it has been in service. Fig. 19 shows the east portal of this tunnel, in which the contact wire is 17 ft. 3 in. above the rails, and Fig. 20 gives a detail of one of the supporting structures in the tunnel.

On branches and coal mine sidings, wooden pole bracket type construction is used. Chestnut poles, guyed with steel strand, carry a bracket made up of two angles and stiffened by bracing. In such places only two of the suspension type insulators are used. The messenger wire is $\frac{3}{8}$ in. steel strand, and the contact wire No. 2/0, no auxiliary messenger being used. Hangers and clips are similar to those used on the main line. Fig. 22 is a typical view of this wood pole construction.

Track Bonds.

A special type of track bond has been designed for this installation. By manufacturing the bonds with

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only one terminal attached, and crimping or looping the cable near one end, the bond may be installed by removing only one bolt in the fishplate. In this way these bonds may be installed almost as quickly as the exposed type while retaining all the advantages of the concealed type. The method of installation requires a bond sufficiently rigid to be pushed between the rail web and the fishplate, hence the cable consists of 37 strands of 0·0534-0·475 in. copper wire. As received from the manufacturer, the bonds consist of a 36 in. cable with a terminal welded on one end; the free end of the cable is merely tinned to prevent separation of the strands. After the bond has been slid under the fishplate, the free socket terminal is soldered on; both terminals are then expanded into holes in the rail web by means of steel drift pins. At signal gantries (Fig. 21) the rail joints are insulated, and it is necessary to instal bonds so that the flow of propulsion current shall be continuous. This result is accomplished by the use of impedance bonds, which prevent the flow of 60-cycle signal current from getting past the insulated joint, but at the same time do not at all interfere with the flow of the 25-cycle propulsion current.

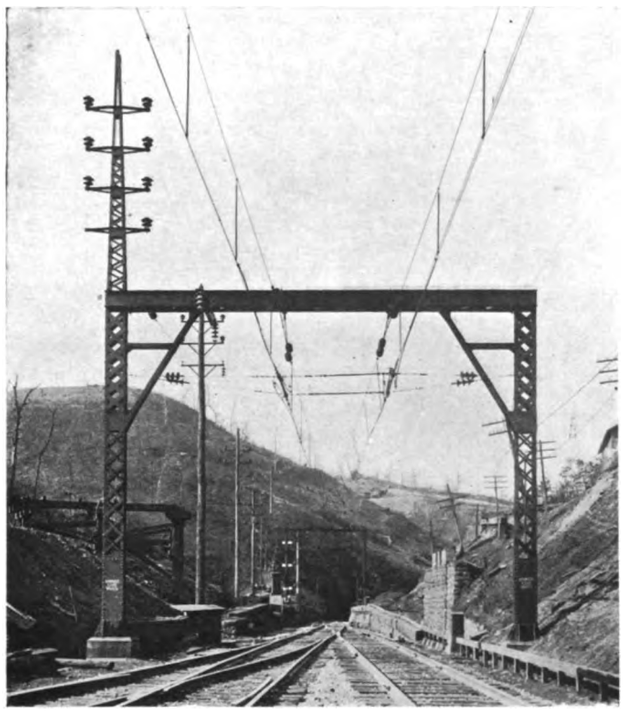

Fig. 19.—Approach to East Portal of Elkhorn Tunnel.

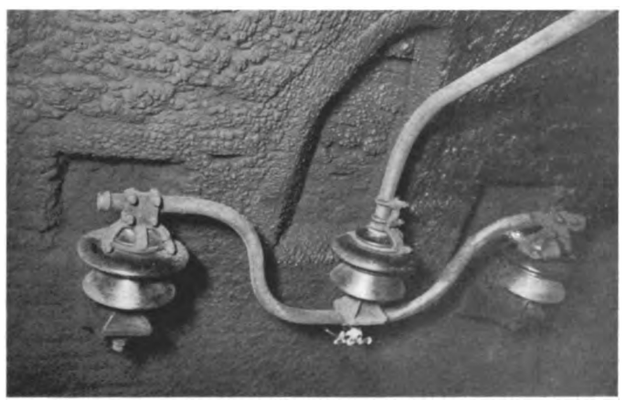

Fig. 20.—Bracket Supporting Catenary in Tunnel.

Protection of Telephone and Telegraph Lines.

In order to protect the telephone and telegraph lines along the railway from danger of interruption of the service due to the electrical installation, it was necessary to make certain provisions, first, against the hazard of physical contact between falling telegraph wires and high tension power wires, and, second, against induction set up in parallel telephone and telegraph lines due to current flowing in the power circuits. The telegraph and telephone pole line was formerly placed close to the track, and its location was changed from the north to the south side of the right of way at frequent intervals for convenience in construction when originally installed. It is, of course, not permissible to have these small wires crossing over high voltage power lines, and therefore it was found preferable to move the telephone and telegraph lines entirely to the north side of the tracks, and place them at the extreme edge of the right of way, so as to be as far as possible from the power circuits. It should be noted that the 60-cycle, 4,400 volt signal circuit is located on the catenary structures along the north side of the tracks, and as the load on this circuit is small, and the voltage is such that the telephone and telegraph lines can readily be protected against the signal voltage, the nearest 11,000 volt traction power wire to the telephone and telegraph circuits is the trolley over the northerly or westbound track. Ample clearance therefore has been provided against danger of physical contact being made between telegraph wires and the high voltage power wires.

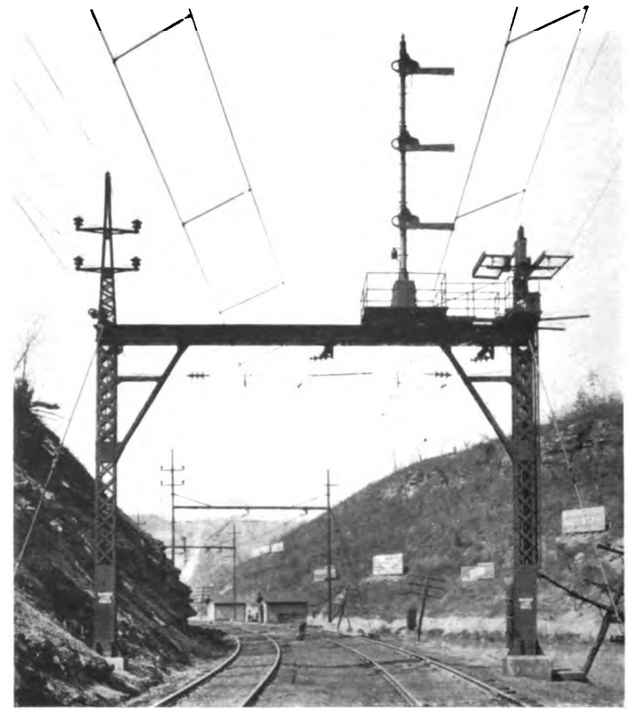

Fig. 21.—Typical Signal Gantry on Curve.

To provide against induction it was decided to place the main transformer sub-stations somewhat closer together than would be required by considerations of voltage regulation and losses and to place the end sub-stations near the ends of the line. This results in feeding each important or long section of trolley from both ends, and thus current fed to the trains in the section between sub-stations flows in both directions in the trolley and

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track circuits, and consequently the induced voltage in parallel telephone and telegraph lines is largely localised and neutralised. In addition to this, however, in order to provide for emergency conditions when one sub-station may be out of service, and for excessively high currents which occur in cases of short circuits and grounds, it was decided to instal so-called track transformers or boosters in the trolley and track circuit at intervals of about one mile. These are series transformers, having the primary windings connected in series with the trolleys and secondaries in series with the tracks at the middle point of the impedance bonds which are required at signals. These booster transformers are mounted on signal bridges, and the track connections are carefully worked out so as not to interfere with the functioning of the signals. The purpose of these transformers is to cause the return current, a considerable amount of which would ordinarily leak to earth, to flow in the track rails, and thus keep it at a fixed distance from the trolley wire and the telephone and telegraph wires. The rails and the trolley wire occupy approximately symmetrical positions with relation to the telephone and telegraph circuits, and as the current is flowing in opposite directions in trolley and track, the effect is to largely neutralise the induction in the telephone and telegraph lines. All of the above provisions, while they are made primarily to protect the company's own telephone and telegraph circuits, which are nearest to the track, also serve to neutralise and minimise the tendency to induce voltages in the telephone lines of other companies.

Fig. 22 shows a signal gantry on which a booster transformer is erected. There are two sets of coils wound on the core of each transformer, one for the eastbound and the other for the westbound track, hence only one transformer is required at each point. By the use of a combination of all the above appliances and devices it is found that the telephone and telegraph service is not interfered with by the operation of the electric train service.

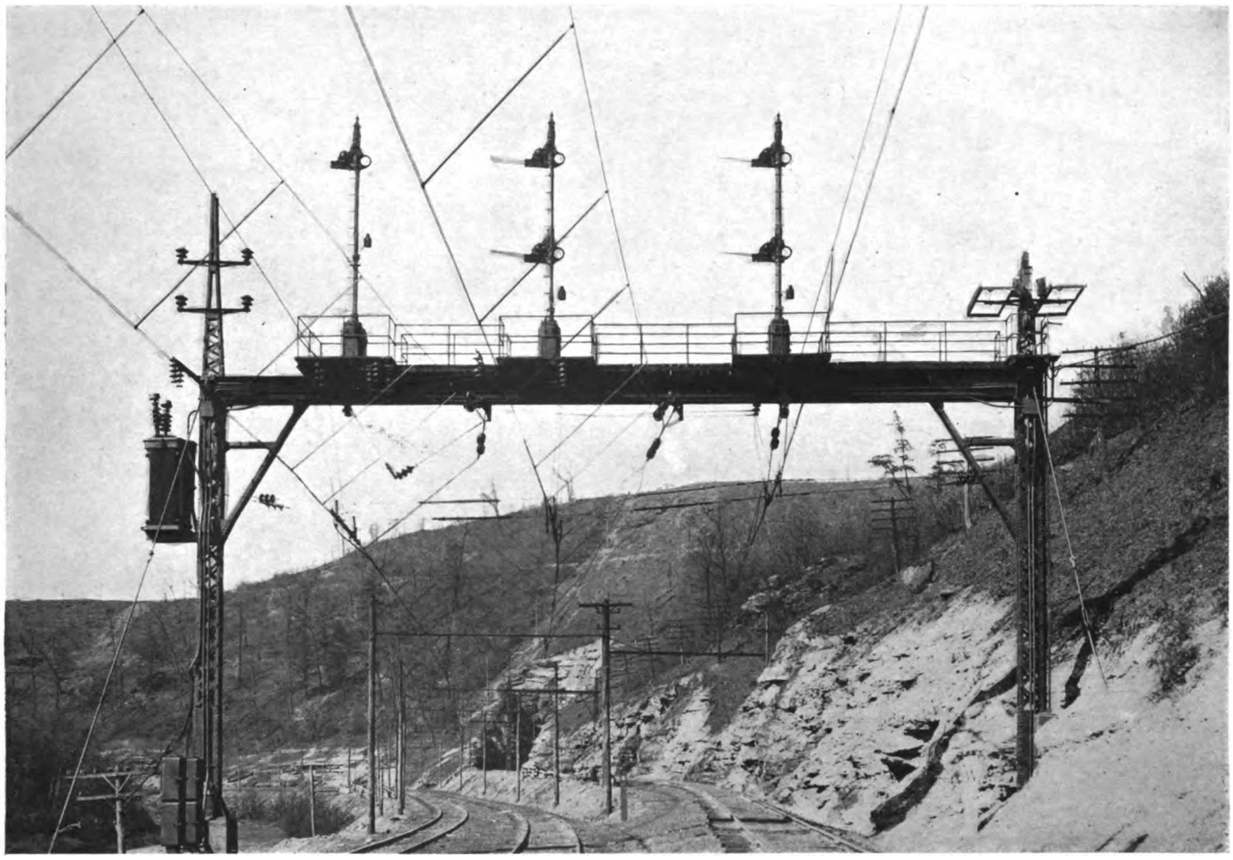

Fig. 22.—Typical Combined Signal and Catenary-carrying Gantry.

LOCOMOTIVES.

The traffic on the electrified section is handled by twelve 270-ton Baldwin-Westinghouse locomotives, each consisting of two 135-ton units or halves (Fig. 23-29). It is necessary in handling heavy trains on mountain gradients to have a part of the motive power at the rear of the train to avoid excessive strains on the draught rigging of the cars. In this case the power is divided equally between the two ends of the train, and the trains are of such great length in this mountainous country that there is difficulty of signalling from one locomotive to the other, and thus the locomotives are subject to treatment which would be considered impossible in ordinary service. For instance, it is not unusual for the rear locomotive on receiving a starting signal to stand still for a minute while exerting full power in an effort to start the train before the head locomotive has got into step with the pusher, especially when the rail conditions frequently result in slipping of drivers, or when the air-brakes do not release promptly.

Under these conditions the train must frequently be allowed to drop back a little and the start repeated. Also, in stopping a train the head engine shuts off power and the brakes are applied, while the rear engine keeps pushing the train until it comes to a standstill. This would require some very careful handling with the ordinary locomotive, but this one is designed to meet just these severe requirements of the service, and that without involving special manipulation. In meeting these conditions the rugged construction of the three-phase induction motor being free from commutators

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and the liquid rheostat are of the greatest importance. The liquid rheostat not only gives the smoothest possible gradations of tractive effort, but the latent heat of steam makes it possible without difficulty to dissipate the large amount of heat generated in the rheostat in meeting these severe requirements. The inherent characteristics of the induction motor, which enable the locomotive automatically to hold the train at a constant speed on descending grades by regenerating and returning power to the line, also accentuate the advantages of this type of locomotive.

Each unit (Figs. 24-27) has two main trucks connected by a Mallet type hinge, and each main truck has two driving axles in a rigid wheel base with a radial two-wheel leading truck. The bumping and pulling stresses are transmitted through the main truck frames and through twin draught rigging mounted on the main trucks at each end of the unit. The cab is of the box type, and is supported on the main truck entirely by spring-cushioned friction plates, there being no weight on the centre pins, which serve only to maintain the cab in its proper position on the trucks. In addition to end doors, a side door is located at each end of the cab on the engineer's side. An engineer's compartment is provided at one end of each unit, the two units being so coupled as to provide for operation from either end of the locomotive. Each locomotive is equipped with eight traction motors of the three-phase induction type, with wound secondaries for four-pole and eight-pole operation. The motors are forced-cooled by air from the main ventilating duct, which also delivers air to the phase converter and to cooling towers for the liquid rheostats.

There are two running speeds, 14 and 28 miles per hour. In starting, resistance is inserted in the secondary circuit of the motor by means of a liquid rheostat. For the 14 miles per hour speed all motors are connected in parallel, having the eight-pole motor combination, and for the 28 miles per hour speed they are also connected in parallel, but with the four-pole motor combination. The locomotives are equipped with unit switch type of control, and arranged for the simultaneous operation of the two units from the control end of either. The control equipment is built for handling alternating current, which is collected from the 11,000-volt line by the pantagraph trolleys (Fig. 28). This current is fed to the main transformers through an oil type circuit breaker. A phase converter is connected to the low tension side of the transformer, and operates constantly when the locomotive is in service. To its extended shaft are coupled a blower for cooling the motors, transformers, and other parts, and, through a clutch, the air compressor. The converter is an induction motor with a short circuited or cage wound secondary, having two windings on its stator, one to drive the rotor and the other to furnish current out of phase with the main supply current. The motor circuit of the primary winding of this converter is connected across the secondary of the locomotive transformer and receives current at 725 volts. The arrangement of windings is such that, with the converter running, a current of 90 deg. phase displacement is induced in the second winding on the primary of the converter. By connecting this displacement circuit to the middle tap of the main transformer, a three-phase current is produced by the ordinary two-phase three-phase method of connection. It is only necessary to convert a portion of the current used in the main motors, as a large portion comes directly from the main transformers.

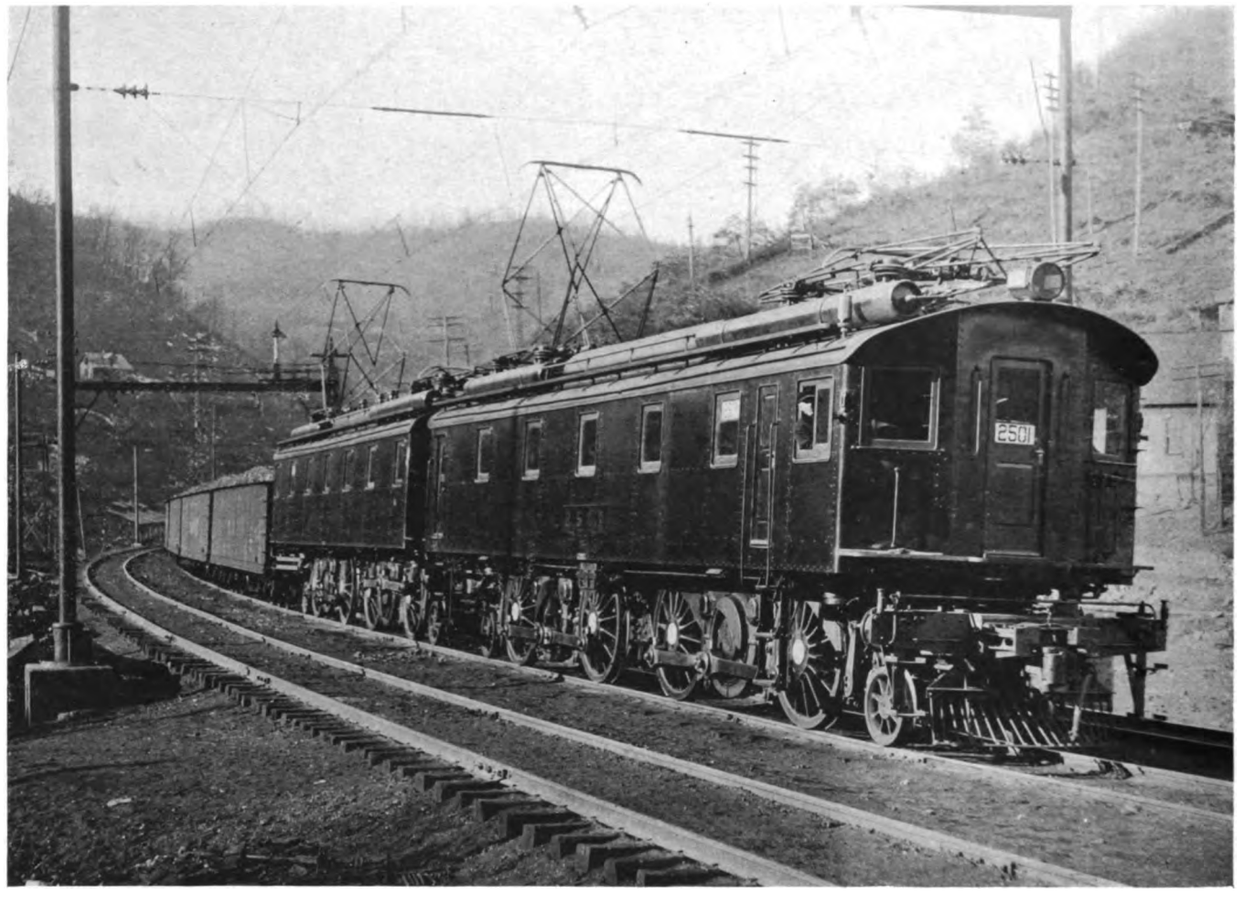

Fig. 23.—Double Unit Electric Locomotive Hauling Heavy Coal Train.

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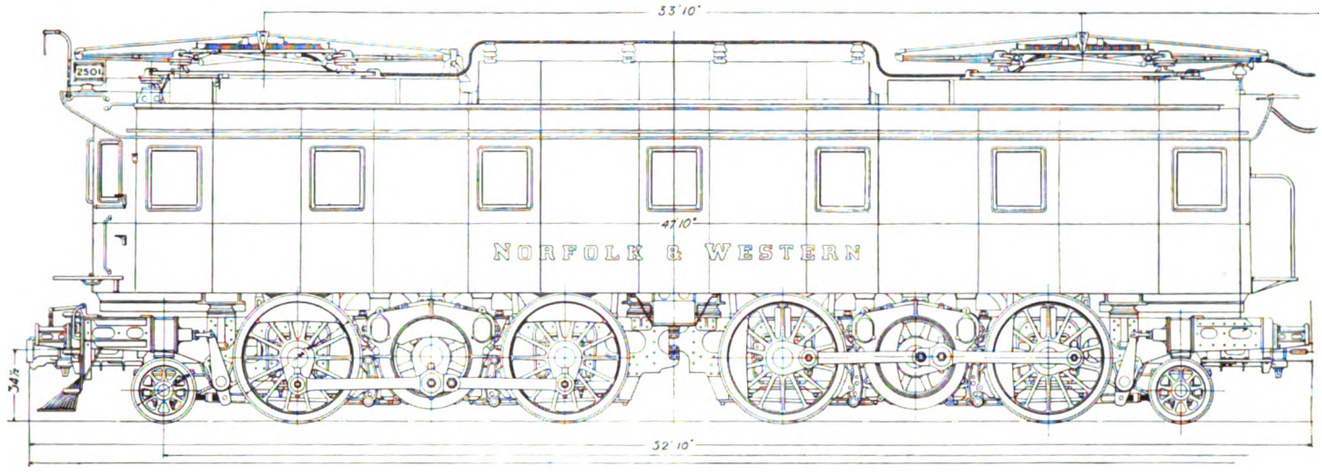

Fig. 24.—Side Elevation of Single Unit or Half Locomotive.

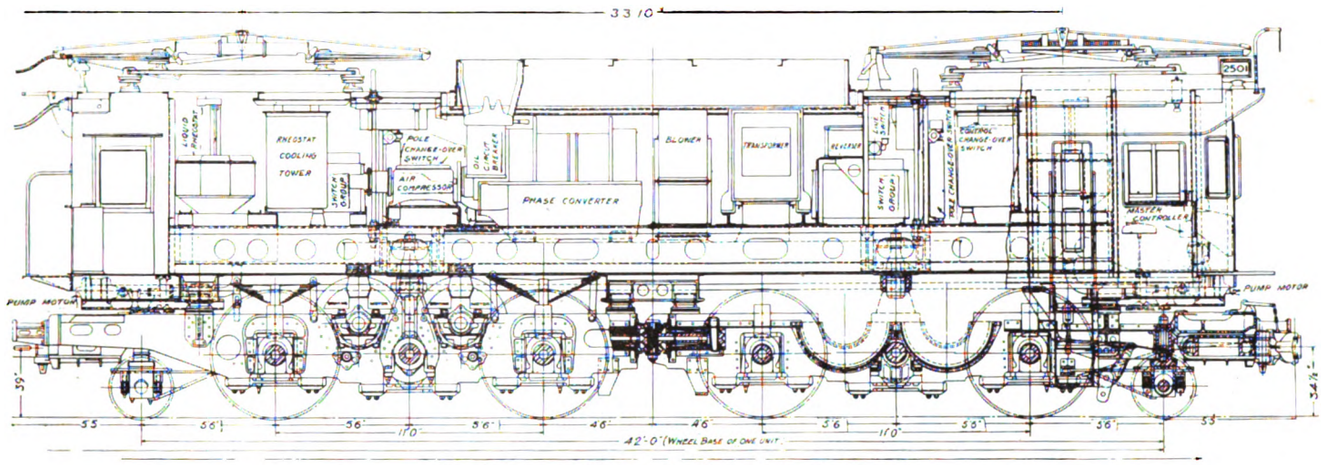

Fig. 25.—Longitudinal Section of Single Unit.

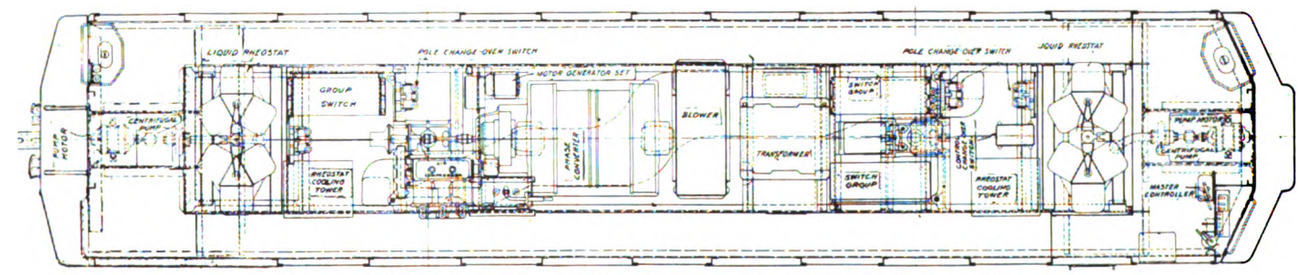

Fig. 26.—Plan of Single Unit, showing Arrangement of Equipment.

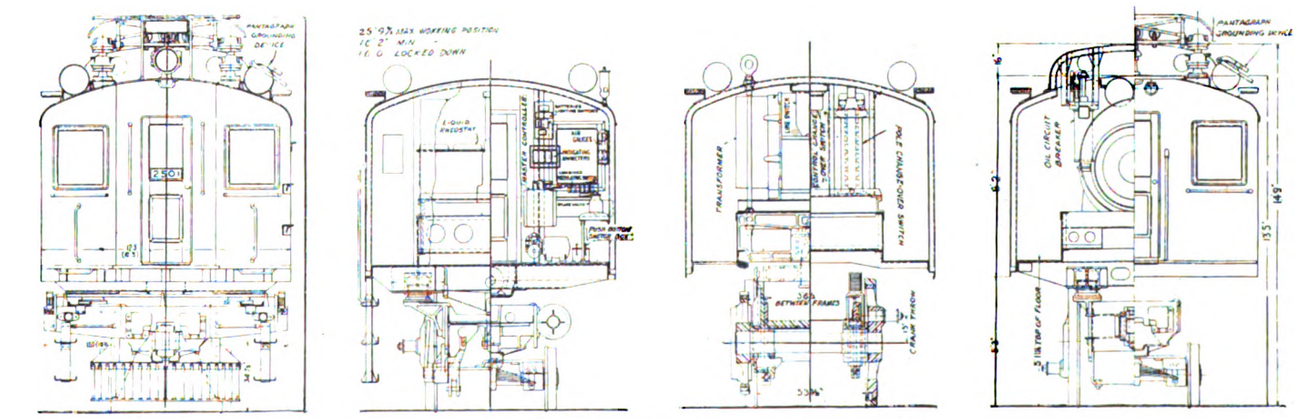

Fig. 27.—End Elevations and Cross Sections of Unit.

ELECTRIC LOCOMOTIVE UNIT—NORFOLK AND WESTERN RAILROAD.

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For starting the converter a single-phase series commutator type motor is mounted directly on the shaft of the converter. The phase converter is forced ventilated, having a connection at its centre to the main ventilating air duct of the unit. Two trolleys are mounted on the roof of each unit; they are of the well-known pantagraph type, but are unique in that they have been arranged so that if necessary they may be fitted with end horns, which will automatically fold in when the pantagraph is lowered by the tunnel trolley wire. In this way the unusually wide sliding surface will accommodate itself to the restricted tunnel clearances. The trolley is raised and held in contact

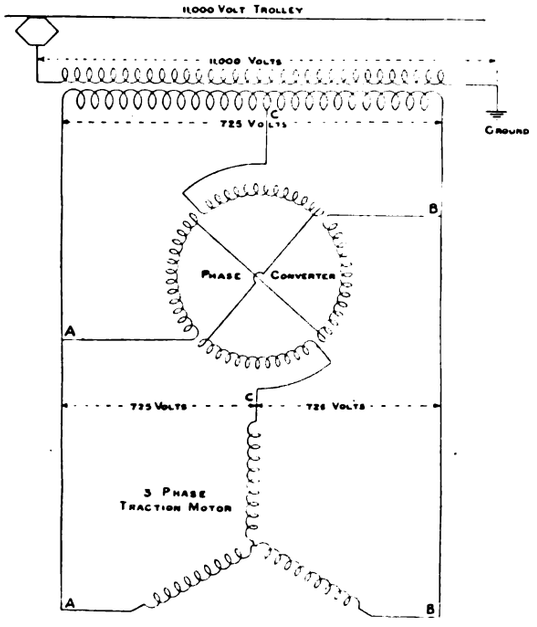

Fig. 28.—Locomotive Connections from Trolley Wire through Phase Converter to Traction Motors.

with the overhead wire by springs, and is lowered by compressed air. When locked down the trolley can only be released by air pressure. When air is not available in the reservoirs one trolley on each unit is arranged so that it may be unlocked and allowed to rise, being raised by means of a small hand pump. Double insulation is provided for the pantagraphs, that is, two separate sets of insulators are arranged in series. If one set fails, the other set will be effective in sustaining the service. On each unit there are four liquid rheostats, one for each motor. The rheostats are operated in pairs, each pair having in common one storage reservoir and cooling tower, one circulating pump, and one operating mechanism. The liquid rheostats provide the motor circuit resistance required in order that the speed of the motors may be slow at starting, and may be gradually increased as the resistance is cut out of circuit.

The essential elements of each rheostat are a cast-iron tank in which are mounted electrodes consisting of certain metal plates connected to the motor, and another set of such plates adjacent thereto and connected to ground; a hollow plunger, located at the centre of the tank for regulating the height of the liquid which is raised or lowered by an operating mechanism; and a motor-driven centrifugal circulating pump by which the liquid is continuously circulated to prevent excessive heating, the liquid being forced up through the bottom of the tank and over the top of the hollow plunger when the plunger is raised, and back through the inside of the plunger to the storage reservoir. When the liquid is raised so as to submerge the lower ends of the plates, current may flow between the motor-connected plates and the adjacent ground-connected plates, the circuit between the three phases of the motor being thus established. The higher the liquid rises on the plates, the lower the resistance becomes; when the plates are entirely submerged, the liquid going all the way up, the resistance is reduced to the minimum.

To keep the temperature of the circulating liquid as low as possible a portion is by-passed through a cooling tower containing a series of trays so arranged that the liquid will flow over them in a thin sheet, and be cooled by air from the main ventilating duct to which the towers are connected. For the purpose of cooling the various pieces of apparatus there is a 36 in. sirocco fan mounted on the shaft of the phase converter, and arranged to deliver the air to a duct built into the cab floor under the deck. The duct runs lengthwise through the cab, and is arranged with openings at various points where connections are made to the traction motors, phase converters, cooling towers, etc.

The electrical equipment has been designed to provide for electric braking on grades by regeneration, both for the purpose of safety and economy of operation. These features bring about a decrease in the wear and tear of the brake equipment and a reduction on the demand on the power system, provided, of course, regeneration takes place at the same time that power is required for other purposes. The following table shows the principal dimensions and weight of each complete locomotive:—

	Ft.	in.
Length overall	105	8
Driving wheel base, total	83	10
Rigid wheel base	11	0
Truck wheel base	16	6
Height, rail to pantagraph (locked)	10	0
Height, rail to top of cab (maximum) ...	14	9
Width overall (maximum)	11	6¼
Width over cab body	10	3
Diameter of driving wheels	0	62
Diameter of pony wheels	0	30
Weight on drivers	220 tons	
Total weight of locomotive	270 tons	

The following table shows the performance of these locomotives under varying conditions of load:—

	Train on 1·5 and 2 per cent. grades.	Train on 1 per cent. grades.	Train on 0·4 per cent. grades.
Weight of train, tons	3,250	3,250	3,250
Locomotives per train	2	1	1
Approximate speed, miles per hour ...	14	14	28
Drawbar pull per locomotive, pounds:			
Uniform acceleration	91,800	114,000	79,400
At speed on 2 per cent. grade ...	75,400	–	–
At speed on 1 per cent. grade ...	–	85,800	–
At speed on 0·4 per cent. grade	–	–	4,000
Maximum guaranteed accelerating tractive effort per locomotive	133,000	133,000	90,000
Approximate maximum guaranteed H.P. developed by motors ...	5,000	5,000	6,700

On tests and in service the locomotives have developed a drawbar pull considerably in excess of the guaranteed maximum, the highest record with the dynamometer car being 180,000 lb. This corresponds to an adhesion of about 40 per cent.

FACILITIES FOR INSPECTION AND MAINTENANCE.

As has been explained in a general way, special care has been taken to ensure adequate facilities for the inspection and maintenance of the entire electrical installation, and these have been centralised at Bluestone, where the power-house is situated. The facilities

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provided are the following :—The inspection building is intended primarily for the inspection and maintenance of electric locomotives, but the machine shop established in connection therewith also serves the power station, and thus the necessity of installing machine shop facilities in the power station is avoided. The inspection building and repair shop is a 148 ft. by 68 ft. structure of the same type as the power station, which is just north of it. There are two main pits running the full length of the building. As the locomotives are 105 ft. 8 in. long the shops have a maximum capacity of two locomotives or four units. The pits are substantially constructed of concrete with sloping floors and numerous outlets to provide drainage, and are equipped with electric wiring for lighting and power purposes, and with compressed air at about 100 lb. per square inch. At the west end of the shop is a short wheel pit, which is connected to the two other pits by means of a covered lateral pit. This pit is equipped with a narrow gauge track to handle the pneumatic jack by means of which the wheels are removed from the locomotives and run along to the storage track in front of the heavy wheel lathe. The southern pit is used almost exclusively for inspection. For this purpose a 112 ft. platform has been provided 12 ft. 8 in. above the rails, and extending close to the locomotives on the tracks.

All repair work is done in the northern part of the building, where the machine tools are situated. This part of the shop, as well as one inspection pit and the short wheel pit, are spanned by a 30-ton Whiting crane. It is equipped with four motors and two hoists, the main hoist having a capacity of 30 tons and the auxiliary hoist having a capacity of 5 tons. The motors are of the General Electric "MD" type, those for the main hoist and bridge travel being of 30 H.P. capacity, and those for the trolley travel and auxiliary hoist being respectively of 5 and 16 H.P. capacity.

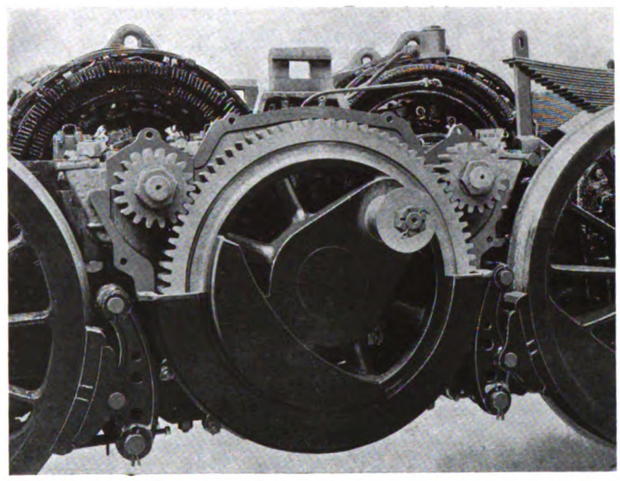

Fig. 29.—Motors, Gear, and Shaft on Truck of Electric Locomotive.

The following machine tools are installed :—

Motor-Driven Tools—

80 in. heavy wheel lathe.
30 in. by 8 ft. planer.
60 in. by 6 ft. No. 1 horizontal boring and drilling machine.
3 ft. Mueller radial drill.
20 in. Stockbridge crank shaper.
73 in. boring mill.
36 in. double back geared lathe.

Belt-Driven Tools—

One Style "C" Diamond double emery grinder.
One No. 5 mat Diamond wet tool grinder.
36 in. Aurora vertical drill.
18 in. by 10 ft. single back geared lathe.
14 in. Barr 2-spindle sensitive drill.
50-ton pneumatic press.

The locomotives are not handled in the shop by their own power, but are drawn in and out by means of a cable and motor-driven winch, placed at the east end of the building between the two main tracks. A blacksmith's shop is placed in an extension at the north-west corner of the building. This is equipped with a forge and a pneumatic drop hammer.

Line Maintenance Equipment.

For the maintenance of the overhead catenary trolley construction and the transmission lines the brick building at Bluestone formerly used as a pumping station for locomotive water supply is used as headquarters for the line inspection and maintenance force. Here a supply of line materials will be carried, and part of the building will be fitted up as a sleeping quarter for line repair men, who will thus be available and subject to call at any time during the day or night. On a siding near by will be stationed an emergency repair train, consisting of a tower car, tool car, and flat car, which is constantly held in readiness for heavy emergency repairs; the ordinary repairs, however, will be made by comparatively small gangs, consisting of three to five men, who will be sent out on small gasolene cars fitted to carry tools and an assortment of wire, insulators, and other repair parts and extension ladders. Three of these emergency gasolene cars with equipment are provided. Wherever possible repairs are made from the overhead bridges or from ladders, and in order to avoid interruption to electric service to the greatest extent possible, specially treated and impregnated wooden ladders are provided, and can thus be used for light repairs to trolley fingers, clips, and other details on the 11,000 volt catenary system while alive. Very rigid rules are enforced which permit the use of only one ladder at one point at the same time, and only one man on the ladder, and also prohibit the use of long lengths of wire which might reach across to other wires or to a grounded structure. Certain of the line repair men are regularly stationed at one or two other points on the line from which they can quickly respond to an emergency call by the use of petrol motor cars.

In order to expedite the inspection and maintenance of the line, a patrol telephone line is installed over the entire length of the electrified section, and telephones in locked boxes are provided at certain signal bridges spaced about one mile apart. This patrol line is connected with the power-house, and is valuable for use in reporting either line or locomotive troubles, and through the power-house telephone operator communication can be had over this line with the train despatcher and other officials. The power director located at the switchboard in the power station is also in constant telephone communication with the signal tower operators, passenger station agents, yard masters, and others who are responsible for manipulating the switches in the sub-stations or along the line. By means of the above facilities power can be switched off or on quickly whenever necessary, or the line be sectioned and service restored in part or in whole after interruption. The former automatic signals of the "DC" type requiring storage batteries, which were only recently installed, have been relegated to other parts of the railway; and on the electrified section new signals have been provided. They are connected to the A.C. track circuits and are placed on the catenary gantries.

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LONDON, JULY 8, 1915.

A Novel Railway Electrification Scheme.

A large part of this issue is devoted to a full description of the electrification of a section of the Norfolk and Western Railway, an American system well known in this country. In view of the novel departure in methods which the undertaking presents, as well as the care and skill with which the whole installation has been designed, the description will be examined with lively curiosity, especially by many railway men who are closely following every new development in electric traction. For the present, British railways are precluded from active participation in progress in this direction; but we shall be greatly surprised if the end of the war does not signalise the beginning of a period of renewed enterprise on the part of our railway leaders. The epoch of electrification was, in fact, already beginning when the European catastrophe suddenly postponed it. Sufficient advantages have, however, been proved to arise from electric traction to invest every fresh development with deep interest. In regard to the Norfolk and Western scheme, it will in the first place be remarked that it adds another example to the rapidly-growing number of railways in America which are being electrified for the purpose of hauling mineral trains of enormous weight over heavy gradients. The electric locomotives are much more powerful than even the greatest of the huge Mallet steam locomotives which are used for such work. But the novelty lies in the fact that single-phase alternating current is used for transmission from the power-station to the sub-stations and from the latter to the trolley wires, while by means of phase-converters carried on the locomotives the current is changed into three-phase, and in that form is applied to motors on the locomotive. Thus the advantages of three-phase motors are obtained with the use of a single overhead wire per track, instead of the two wires which would be necessary if three-phase transmission from the sub-stations to the line were employed. The need for two wires has been an obstacle to the development of three-phase traction in America, and apparently that obstacle is now removed. For a service of the kind, namely, infrequent but very heavy trains, running with few if any stoppages over steep gradients, the three-phase motor is more efficient than the single-phase commutator motor. It is lighter and it is cheaper to run owing to the absence of a commutator and the consequent cost of upkeep through bad commutation of the single-phase machine. The control gear also is simpler. When motors can be mounted inside the cab of the locomotive, a more efficient motor can be obtained at a lower speed, allowing the use of simple cranks and connecting rods for driving, instead of the comparatively inefficient spur gearing. It is true that acceleration with a three-phase motor is low, and therefore it is not suitable for a service where there are frequent train stoppages, but that consideration does not apply where trains go right through without stoppages. The control arrangements in this case admit of two running speeds, 14 and 28 miles an hour, the latter being obtained by cutting out four of the eight poles of each motor. The phase converter is a form of single-phase induction motor with squirrel-cage rotor and two primary windings on the stator. The current from the line passes through a transformer to reduce its pressure before reaching the phase-converter. The apparatus over all is thus more complicated and heavier than if three-phase current were used on the overhead wires. It could be led direct to the motors without the need of either transformers or

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phase converters. It seems to us doubtful whether this system will prove as advantageous as ordinary three-phase or high-tension direct-current traction, the latter of which is now being used with marked success on other heavy mineral railways as well as for lighter work.

London Local Authorities and Omnibus Powers.

"That powers should be obtained jointly to run omnibus services" was one of the resolutions passed some weeks ago at a conference of managers of the municipal tramway undertakings within the Metropolitan area. The resolution has since been submitted to the various tramway-owning authorities in that area, and it has been endorsed by Croydon Council. This action was opposed by the leader of those members who object to municipal trading, but there are other grounds than that rather out-of-date consideration for questioning whether the proposal is practicable in the sense in which the managers desire to see it brought into operation. The logical interpretation of the managers' scheme is that they desire their respective Councils to enter into competition with the London General and four other omnibus undertakings now working in and around London under a co-operative agreement. The fact that these latter companies have all come to an arrangement with the leading organisation is evidence that competitive working is impracticable if profits are to be made. Equally unattainable is any dream of building up so great an organisation as that which now holds the field. No municipal authority would dare to embark upon such an adventure, which would only end in becoming a rival undertaking to the tramways, to the great detriment of both. Another consideration that ought not to be lost sight of is the probability of Parliament deciding greatly to increase the taxation of heavy motor vehicles. Whatever course the outer London Councils may adopt, the prediction can be made with some confidence that the County Council is not likely to enter upon any expenditure for the running of self-propelled vehicles over its tramway routes. We doubt if they would even be likely to be tempted by the prospect of securing adequate returns from services that would link up central London with various tramway termini, together with extensions to outskirts where there are no tramways. The benefits of linking up may be obtained without any expenditure providing a working agreement can be arranged between the Council and the General Omnibus Company. This should not present insuperable difficulties, for a through running arrangement has now been in operation for two years between the Council and one of the allied tramway companies. The tramway managers' scheme would prove more convincing if they had specified the directions in which their Councils should jointly run omnibuses in view of the strenuous competition to be encountered. No doubt there are directions in which the outer Councils could employ a few vehicles locally; in fact, one such instance was indicated during the Croydon Council's discussion.

The Shortage of Men.

Tramway authorities have for some months found the problem of securing men of non-military age to be one incapable of solution. London, perhaps, affords the best place for obtaining that description of labour, but the lack of it is manifest by the falling off to a six minutes' service during the part of the day not comprised in the rush hours. This curtailment is greatly to the advantage of the motor omnibuses, which on tramway routes do not seem to have diminished in number. While provincial managers are not labouring under London's disadvantage of a wholesale displacement of men of military age due to a strike, they long ago found that the maintenance of their services would become impossible unless some other source of labour could be found. Nearly all of the largest undertakings have now employed the aid of women as conductors, and many of the smaller ones have done likewise. Unfortunately this form of assistance will not be available for any of the London tramways unless their owners take concerted action to overcome the opposition of the police. With the successful work of women conductors in the provinces to point to, it ought not to be difficult to persuade the Home Office to overrule the fiat of Scotland Yard. Representations should also be made to the War Office on behalf of tramway authorities generally to secure the issue of an instruction to recruiting officers not to accept any more employees for the Army

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unless they can produce a certificate that their services can be spared. This course has already been adopted in the case of railway companies, and a strong case can be advanced in favour of its application to tramways. Any further curtailment of the means of conveyance must hamper not only the general business of the country, but the manufacture of war munitions. In return for the War Office concession it might be possible for a number of other tramways to follow the example of Liverpool in giving the employees the opportunity to devote their spare time to the work of increasing the supply of munitions. Successful as the introduction of women conductors has proved to be, there is no possibility of utilising women to drive cars. As the supply of paid men for permanent service in that capacity has been exhausted, there is no alternative but to call for volunteers. A beginning in this direction has been made at Newcastle and Coventry, while at Cardiff the management has intimated that assistance would be welcome. The men so obtained are above the recruiting age, and in some cases are unfitted for military service. No time ought to be lost in bringing all the facts of the case before the military authorities, as the duty for which many tramwaymen are being enlisted could be entrusted to discharged soldiers.

TRAMWAYS AND LIGHT RAILWAYS ASSOCIATION.

THE SUMMER MEETING.

Owing to the war the usual summer congress of the Tramways and Light Railways Association has this year been limited to a one-day meeting, to be held in London on July 16 at the Institution of Civil Engineers, Westminster, S.W. The annual meeting of members will be held at 10.30 a.m. on that day, and this will be followed by a general meeting, at which the following papers will be read and discussed :—

"Glimpses into the Obvious" (notes on tramway management), Mr. A. V. Mason, general manager, South Metropolitan Tramways.

"Tramways During War Time." Mr. J. W. Dugdale, general manager, Oldham Corporation Tramways.

"Electric Battery Vehicles as Adjuncts to Tramways." Mr. W. H. L. Watson.

At 7.30 p.m. there will be an informal dinner of the members at the Trocadero Restaurant.

PANAMA EXHIBITION ENGINEERING CONGRESS.—We have received from Mr. E. J. Dupuy, executive secretary of the Committee of Management of the International Engineering Congress, to be held at the Panama-Pacific Exhibition, San Francisco, from September 20 to 25, a pamphlet containing full information with reference to arrangements, excursions, accommodation for visitors, etc. The congress will be held under the auspices of the American Society of Civil Engineers, the American Institute of Mining Engineers, the American Society of Mechanical Engineers, the American Institute of Electrical Engineers, and the Society of Naval Architects and Marine Engineers. A detailed programme of the congress meetings will be published later. Arrangements will be made for special trains from New York and New Orleans, and various excursions have been planned.

LONDON TRAMWAY RESULTS—1914-15.

By A. J. LAWSON, M.Inst.C.E.

COUNTY COUNCIL TRAMWAYS.

In the year ended March 31 last there was the very considerable increase of 23,000,000 passengers carried on the Council's cars over the preceding year's figures, the total number in 1914-15 amounting to 546,127,905 people, on 59,078,792 car miles run, at an average fare of 1·025d. per passenger. Thus 13,000,000 more people were carried than in the hitherto record Coronation year, 1911, but, unfortunately, at a smaller margin of profit.

The passenger traffic receipts were £2,333,314, representing an increase of revenue of £131,000 compared with the preceding twelve months, and showing a gradual increase from £44,000 per week at the beginning of the financial year to £47,000 per week at its close—not taking into account the usual slack season in August and September, when the number of passengers fell in one week to the low total of 9,422,500 and the traffic revenue for the same week (September 23) to under £42,000, which results were the poorest, except for the black week of the breakdown at the Greenwich power house in December last, when the passengers carried numbered only 8,724,102, and the traffic revenue was but £36,750. But for that calamity, which caused the loss of £10,000 in revenue, and the interruptions caused by the snowstorms of January and February, it is probable that the Council's tramcars would have carried 550,000,000 passengers and the traffic revenue would have reached £2,350,000.

About one-quarter of the increase was no doubt due to the withdrawal from competing routes of the motor omnibuses which were taken abroad for war transport, but most of it was undoubtedly owing to the increased mileage of electric lines, and replacement of horse-drawn cars by the speedier and less costly-worked electric vehicles, as well as to the reduction in fares on certain routes and the extension of the system of return tickets, which, strangely enough, has resulted in a slight increase of the average fare compared with the previous year's returns.

At the beginning of April, 1914, there were 137·99 route miles of electrically operated lines and 4·45 miles of horse-worked tramways. By the middle of August the lengths were 141·21 and 1·77 miles respectively, which figures still obtain pending the completion of some short lengths of electric lines now under construction.*

The horse-worked lines carried in the year 3,244,781 passengers, of which number 1,800,000 were carried previous to August 12 at the rate of about 94,000 a week and an average weekly return in fares of £305. With the reduction in length of animal-worked tramway, the average weekly number of passengers has fallen to about 40,000 and the receipts, at an average of ¾d. per fare, to £121 per week, or about half the cost of working.

Of the total number of passengers, approximately 29 per cent. were carried at a halfpenny fare, 42 per cent. at 1d., 7 per cent. at 1½d., and 3 per cent. at 2d., while 5 per cent. took 2d. return and 3½ per cent. 3d. return tickets. About 50,000,000 were "exchange"—nearly all workmen's tickets at reduced fares—which hardly yield working costs and nothing at all for capital charges or renewals. Surely there should be a limit to such philanthropy, and a minimum fare of 1d. instead of a halfpenny for each passenger! The introduction of the halfpenny fare in London was one of the "mistakes of Moses" of the Tramways. Who will be their Joshua?

* The horse cars finally disappeared from London streets on April 30th, 1915.

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METROPOLITAN ELECTRIC TRAMWAYS COMPANY.

The financial year of the companies ending on December 31, 1914, is not strictly comparable as to results with the County Council's year, but this probably renders the comparison more favourable to the company-owned lines than if their accounts covered the same period.

The above company in 1914 carried 1,100,000 fewer passengers than in 1913, the total number being 93,325,170, and the average fare was 1·20d. per passenger. The route miles worked were the same as in the previous year, 56¼ miles; the car miles run were fewer by 775,837, at 11,479,592 car miles, which gave the slightly higher revenue per car mile of 9·77d., against 9·31d. in 1913. The net revenue was only sufficient, however, to pay 2 per cent. on the ordinary stock, and in the balance sheet particular stress is laid on the contingent liability of £41,515, of which the company guaranteed payment in respect of an outstanding mortgage on the power-station purchased by the North Metropolitan Electric Power Supply Company from the Willesden Urban District Council, as well as the unconditional guarantee by the tramways company of the principal and service fund of £200,000 4½ debenture stock issued by the Tramways (M.E.T.) Omnibus Company, Limited. The renewals fund is also depleted by depreciation of securities by £15,523, the market value on January 2, 1915, standing at £123,370 only, while the cost price was £138,893. The total amount, considering the present condition of the "permanent way," appears to be quite inadequate.

THE SOUTH METROPOLITAN ELECTRIC TRAMWAYS AND LIGHTING COMPANY, LIMITED.

This company shows a decrease of 167,000 in its total of 6,920,702 passengers in 1914 on its 13·09 route miles of line compared with 1913, but the same average fare of 1·50d. per passenger was obtained as in the previous year. The 6 per cent. dividend on the preference shares to the end of 1913 has been paid, and 1 per cent. on account of the cumulative preference dividend for 1914, which practically absorbed all the profit, for, without any return on the ordinary share capital, the amount carried forward is only £351 6s. 8d.

LONDON UNITED ELECTRIC TRAMWAYS.

With 1,211,342 fewer passengers than in 1913, these tramways (of which the route length worked is 53½ miles) carried only 61,433,783 people in 1914, and the average fare was lower at 1·24d. per passenger compared with 1·26d. in 1913. Consequently though the car mileage was reduced by 410,335 miles to a total of 8,996,891 last year, the traffic revenue is only 8·47d. per car mile, and so materially reduced in gross amount as to have hardly justified the ½ per cent. interim dividend paid in July last on the 5 per cent. cumulative preference share capital of £1,250,000. Upon this the accumulated arrears of dividend now amount to the huge sum of £371,875, as mentioned in a note upon the balance sheet.

The £1,000,000 of ordinary share capital is at present of little value except for voting purposes, and even the interest upon the loan capital of £1,649,930 seems none too secure with the depletion of the reconstruction and renewals reserve fund, which, notwithstanding the addition of £12,500 from revenue during the year, is actually lower, at £83,205, by nearly £17,000 than on December 31, 1913, owing to the withdrawal of £29,439 for necessary repairs and renewals in 1914. A further debit charge of £91,000 appears as a loan from the London and Suburban Traction Company; sundry creditors and credit balances, £35,513; debenture interest payable (but not paid) on January 1, 1915, £32,998; and advances from the London County Council of £60,672, against which accumulations of charges the credit balances make a poor showing.

Altogether the first year's working under entirely new management has been less successful than even that of previous years, which may account for the re-transfer of headquarters of this company, and the transfer of allied concerns from Kingsway to St. James' Park Station, after a twelve-months' experiment.

LONDON AND SUBURBAN TRACTION COMPANY.

At the annual general meeting of this company (which controls the other companies already mentioned) the chairman gave the number of passengers carried in 1914 as 246,800,000. Of these it will be seen that the three tramways carried in all 161,719,655, which would leave 85,080,000 as the number carried by the motor omnibuses and other vehicles owned by the M.E.T. and other subordinate companies, such as the British Automobile Company. This, of course, is irrespective of the London General Omnibus Company's traffic.

SOUTH-EASTERN DISTRICTS.

Croydon Corporation.—Croydon Corporation Tramways carried almost 620,000 more passengers last year than in 1913, on an increase of only 1,500 car-miles run. Owing to the rebuilding of the West Croydon railway bridge there was a decrease in car service and in passengers on that section, but the withdrawal of the Tilling omnibuses from the East Croydon and Addiscombe roads gave the tramways about 400,000 more passengers on the Addiscombe Road branch line. The total traffic revenue was, however, only £2,007 more than in 1913, though the average fare was slightly higher at 1·062d. per passenger compared with 1·060d. in the previous year.

Bexley.—The Bexley Urban District Council had an increase of 682,324 passengers on its tramcars, but owing to a slightly lower average fare of 1·326d. per passenger, compared with 1·554d. in 1913, the yield in gross traffic receipts was only £1,615 higher than in the previous year. The car-miles run were 47,500 more, and the passengers per car-mile were nearly one more than in 1913, but owing to the above-mentioned reduction in fares the takings per car-mile were actually less than in the previous year.

Erith.—Erith's tramways showed an increase of 277,726 passengers on a reduction in car-mileage of 22,352, and a total increase in traffic receipts of £806, with 11·085 compared with 9·617 passengers per car-mile in 1913, at the slightly lower average fare per passenger of 1·010d.

Dartford.—Dartford's leased tramways carried fewer passengers than in 1913, and the car-mileage run was less by 25,850 miles, but the passengers carried per car-mile were more, and the average fare slightly higher in 1914 at 1·450d. per passenger, and the traffic revenue was £233 greater, though the reduction in number of passengers was 63,015.

EASTERN DISTRICTS.

In the East London districts the average fare in every case save that of Leyton was under 1d. per passenger. At Ilford, where on one side of the tramway line large fields are ploughed and cropped within three minutes' walk of the tramway depot, and market gardens and allotments skirt the track at other points, giving more promise of loads of cabbages than of passengers, the Council lack the backbone to acknowledge their error in adopting ½d. fares, and though there has been an increase of 1,166,525 passengers in 1914 over the number carried in 1913, which was effected on an increase of almost exactly 50,000 in car-miles run, the average

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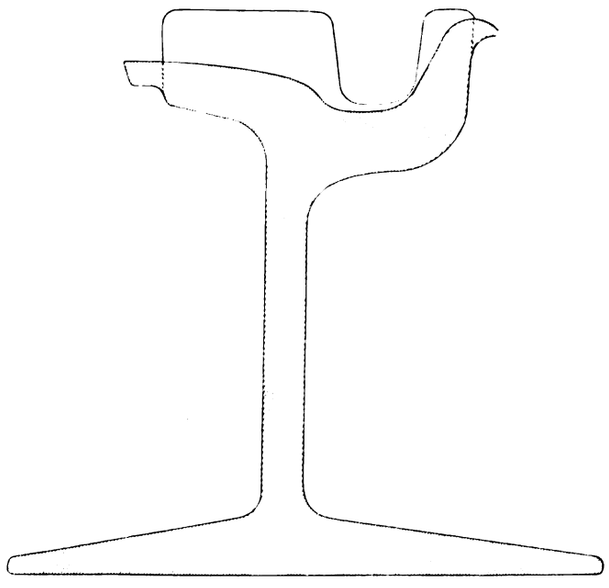
fare of ·770d. per passenger still leaves the undertaking chargeable to the rates for the service of the loan interest and sinking fund, to say nothing of the early reconstruction of the track, the condition of which is indicated by the annexed drawing of the cross section of rail, the shaded part of which shows what still remains of the original section, the form of which is given in outline. The spread of lip and tread is due to heavy motor traffic which pays nothing for damage done, the



cost of which the tramways have to make good in maintenance and reconstruction. Several other lines in the East-end are scarcely better preserved, yet no provision has been made for renewals. How could there be with such average fares as two-thirds of a penny per passenger as at Barking, ·788 at East Ham, ·845d. at West Ham, and ·735d. at Walthamstow, when even the London County Council Tramways, carrying over 546,000,000 passengers in the course of a year cannot meet all charges with an average fare of 1·025d. per passenger? The East London Councillors apparently have not the moral courage to acknowledge and rectify their mistakes. They are likely to drive away residents from their districts by ruinous rating as they have already driven away business. Threepence per week saved on tramcar fares will not go far to pay rates of 10s. or 12s. in the £ on a rateable value of even £26, which is about the value of most of the private houses in these districts.

The annexed table of results for all tramway undertakings in the Metropolitan area for the year 1913 as given in the Board of Trade Return published in January last, and those for 1914 will make the position clear to the reader, and, it is to be hoped, to Urban District and Corporation Councillors whose self-placed halos as givers of "cheap tramcar rides" are in danger of dissolving, on the landlord's imminent demand for higher rents in consequence of the increase in rates due to tramway losses and reconstruction costs.

The whole of the tramways in Greater London show poor financial results, even where the fares are high, owing in some cases to excessive cost of construction and equipment. In the Eastern districts the results are deplorable, for though in many cases the cost of construction was not excessive, the adoption of halfpenny fares handicapped the undertakings from the start, and the only hope of financial salvation lies in the adoption of a minimum fare of a penny, with halfpenny additions for distances in excess of the penny stage and its multiples, however long.

A glance at the figures in the following table should instruct even an Urban District Councillor :—

SUMMARY OF PASSENGERS.

	1913.	1914.
London County Council Tramways	522,952,640	546,127,995
Companies	164,159,223	161,670,055
South Eastern Local Authorities ...	26,772,703	28,280,254
Eastern Municipal and „ „ ...	98,181,538	101,808,074
	812,066,104	837,905,640

Name of Undertaking.		Car Miles Run.	Passengers Carried.	Traffic Receipts.	Passengers per Car Mile.	Receipts per Car Mile.	Average Fare.	Remarks.
				£		d.	d.	
London County Council Tramways ...	1914	58,978,792	546,127,995	2,333,314	9·105	9·337	1·025	Car Miles ... Electric 58,706,161 Horse Cars 272,631
	1913	*59,209,289*	*522,952,640*	*2,302,489*	*8·832*	*8·928*	*1·011*	Passengers ... Electric 542,883,214 Horse Cars 3,244,781
London United Electric Tramways ...	1914	8,996,891	61,433,783	316,838	6·827	8·452	1·238	
	1913	*9,407,296*	*62,645,125*	*328,544*	*6·670*	*8·392*	*1·258*	
Metropolitan Electric Tramways ...	1914	11,479,592	93,325,170	467,415	8·130	9·772	1·202	
	1913	*12,255,429*	*94,426,011*	*469,988*	*7·705*	*9·153*	*1·188*	
South Metropolitan Tramways	1914	1,007,105	6,920,702	44,231	6·872	10·540	1·533	
	1913	*1,112,443*	*7,088,087*	*44,604*	*6·372*	*9·623*	*1·510*	
Croydon Corporation Tramways ...	1914	2,800,672	19,847,402	87,833	7·087	7·526	1·062	
	1913	*2,798,175*	*19,227,878*	*84,926*	*6·872*	*7·284*	*1·060*	
Erith U.D. Council Tramways	1914	335,756	3,721,793	15,673	11·085	11·203	1·010	
	1913	*358,108*	*3,344,067*	*14,867*	*9·617*	*9·963*	*1·036*	
Bexley U.D. Council Tramways ...	1914	364,472	2,952,394	16,313	8·100	10·742	1·326	
	1913	*416,970*	*3,270,050*	*14,638*	*7·162*	*11·129*	*1·554*	
Dartford U.D. Council Tramways (leased)	1914	275,973	1,767,665	10,717	6·405	9·320	1·450	
	1913	*301,823*	*1,830,678*	*10,484*	*6·654*	*8·337*	*1·374*	
Barking Town U.D. Council Tramways	1914	57,591	656,033	1,817	11·391	7·572	·665	Beckton section only now worked by Barking, other sections by East Ham and Ilford.
	1913	*244,818*	*2,368,246*	*6,864*	*9·284*	*6·743*	*·725*	
East Ham Corporation Tramways ...	1914	1,596,984	18,848,148	61,917	11·802	9·305	·788	
	1913	*1,510,251*	*16,671,565*	*54,670*	*11·042*	*8·688*	*·787*	
Ilford U.D. Council Tramways... ...	1914	877,813	9,203,077	29,881	10·484	8·170	·779	
	1913	*827,863*	*8,036,552*	*23,486*	*9·708*	*6·808*	*·701*	
Leyton U.D. Council Tramways ...	1914	1,884,744	17,519,659	75,706	9·296	9·640	1·037	
	1913	*1,815,462*	*17,172,884*	*69,148*	*9·655*	*9·151*	*·950*	
Walthamstow U.D. Council Tramways	1914	1,146,743	13,499,738	41,331	11·772	8·650	·735	
	1913	*1,166,022*	*12,579,852*	*38,567*	*10·789*	*7·938*	*·736*	
West Ham Corporation Tramways ...	1914	3,760,361	42,081,515	147,571	11·191	9 419	·842	
	1913	*3,756,354*	*41,152,501*	*141,325*	*10·955*	*9·030*	*·824*	

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GLASGOW CORPORATION TRAMWAYS.

An abstract statement of revenue and expenditure for the year to May 31, 1915, with comparative figures for previous years, is as follows:—

REVENUE.

	Year to 31st May, 1915. £ s. d.	Year to 31st May, 1914. £ s. d.
Traffic receipts	1,070,694 3 10	1,078,691 7 2
Sundry receipts	6,183 16 0	5,155 10 7
	1,076,877 19 10	1,083,846 17 9

EXPENDITURE.

	£ s. d.	£ s. d
Traffic expenses	345,625 9 2	332,546 9 2
General expenses	142,020 4 6	134,034 1 4
Maintenance and repairs	144,530 0 10	156,214 2 11
Power expenses	51,995 4 5	53,483 0 1
	684,170 18 11	676 277 13 6
European war	51,816 12 8	—
	735,987 11 7	676,277 13 6
Balance carried to Net Revenue Account	340,890 8 3	407,569 9 7
	1,076,877 19 10	1,083,847 3 1

NET REVENUE ACCOUNT.

Balance from Revenue Account	340,890 8 3	407,569 9 7
Dumbarton Tramways	126 9 10	180 0 0
Interest on Investments	65,700 13 7	64,809 4 10
	406,717 11 8	472,558 14 5
Appropriated as under:—		
	£ s. d.	£ s. d.
Rent of Paisley Lines	5,559 0 6	5,830 4 10
Interest on Capital	78,797 9 0	82,921 6 9
Sinking Fund	105,491 11 7	102,666 19 4
Income-tax	22,789 18 1	14,056 9 11
Parliamentary Expenses	8,817 19 4	609 4 11
Renewal and Depreciation	172,310 4 4	212,642 3 8
	393,766 2 10	418,666 9 5
Surplus to be handed over to common good	12,951 8 10	53,892 5 0
	£406,717 11 8	£472,558 14 5

A sum of £76,391 was added to the capital expenditure, bringing the total expenditure on capital account up to £3,751,708. The amount of capital expenditure temporarily provided out of depreciation, renewal, and reserve funds is now treated as having been borrowed from the common good, and the balance of tramway debt owing to the common good now amounts to £2,411,868. Following the decision of the Corporation to take over the third party risk, the sum of £31,000 was placed to the credit of the fund, but the claims and other expenses for the year amounted to only £13,129 18s. The average for year of single miles of line open for traffic is 194 15-16; estimated population served by tramways, 1,150,000; car-miles, 24,214,460; car-hours, 3,210,094; passengers carried, 336,260,758; average number of cars in use (14 hours day), 628·20; average traffic revenue per car-mile, 10·612d. per mile of single track operated, £5,404, per head of population served, 18s. 7d; number of cars, 857.

BRITISH ELECTRIC TRACTION COMPANY.

The report presented to the stockholders on June 25 stated that the progress of the associated companies continued to be satisfactory up to the time when war was declared. The receipts of most of the undertakings were then adversely affected, but on certain lines the receipts increased owing to exceptional activity in particular districts, and during the last few months many of the other undertakings have shown some recovery. Having regard to the general conditions, the board has not undertaken any new enterprises. An agreement has been entered into for the sale of the undertaking of the Devonport and District Tramways Company to the Plymouth Corporation at a price to be settled by arbitration. The gross profit for the year amounted to £235,508, as compared with £225,754 for 1913-1914. After deducting general expenses there remains a balance of £209,295. Including £17,129 brought forward, and deducting debenture stock interest amounting to £91,367, there remains a balance of £135,057. After allocating £11,191 to various reserves against sundry assets, the directors recommend the payment of the dividend for the year upon the 6 per cent. cumulative preference stock, and a dividend of 3½ per cent. upon the 7 per cent. non-cumulative preference stock, requiring £52,467. The remaining balance is £71,398, and in view of the directors' proposal to proceed with the reduction and re-arrangement of capital, it is not proposed to place any portion of this amount to reserve for depreciation, but to carry the whole amount forward. The company has invested in associated and other companies £5,064,825, in Government and municipal bonds £59,134, and in undertakings at Barrow and Mumbles £130,045, giving a total of £5,254,004. Deducting the reserve for depreciation, £482,162, there is a balance of £4,771,842, the yield on this amount being 4·55 per cent., as compared with 4·47 per cent. for the preceding year. Mr. E. Garcke, in moving the adoption of the report at the general meeting on June 25, said the electrical supply side of the undertaking had been well maintained, and one of their allied firms was engaged on Government wo-k which was urgently needed. He felt sure that when the war was concluded local authorities and others would not again be so unwise as to place electrical contracts in Germany for the sake of a slight advantage in price. In the present conditions the company was not starting any new enterprises except such as were necessitated by the war, namely, the manufacture of articles required by the Government. Mr. Garcke announced that the directors intend to call special meetings to carry out the scheme for the reduction and rearrangement of capital, so that when the war was over they would be able to attend to other problems that would then no doubt confront them. The scheme was necessitated by the capital depreciation of investments. But for that depreciation they might have paid a larger dividend last year. It was generally recognised that the main effect of the reduction of capital would be to enable a larger proportion of the net profits to be distributed as dividend than was the case at present. The report was adopted.

BRITISH ELECTRICAL FEDERATION.

The British Electrical Federation, which was established in 1907 to provide managerial, engineering, and other services for its members on a co-operative basis, now comprises some 60 electric traction, lighting, and other companies, having a combined capitalisation of £24,164,215. The total route miles worked by the associated companies is 430 miles, and the companies own 2,000 electric cars and 62 steam cars. In the report just issued it appears that the results achieved during the year 1914, having regard to all the circumstances, were not unsatisfactory. The average fare per passenger during the past year was 1·22d., and the receipts per track mile were £4,817. The number of passengers carried amounted to 405,457,978. The companies employ 380 officers including directors and 13,318 wage earners. The electricity supply undertakings generate 124,476,791 units. During the first few months of the year trade continued to be good, but in the second quarter it showed signs of slackening, and when the war broke out there was a general falling off of passengers and receipts. In the latter part of the year, however, conditions improved to a small extent.

Up to May last the number of employees serving in the Forces was about 2,500, or 20 per cent. of the total number employed by the Federated Companies in this country. A Mutual Aid Fund was inaugurated to provide financial help to the dependents of these employees, and those remaining at work were asked to contribute to the fund. The companies also pay a sum equal to that contributed by the employees, or a minimum of 3d. per week in respect of each man in their service. The fund is administered by a central committee in London.

QUESTION OF CONDUCTORS' AUTHORITY.

WHITTAKER *v.* LONDON COUNTY COUNCIL.

An important question affecting the liability of tramway authorities for the acts of conductors was raised in an appeal heard recently before the King's Bench Divisional Court—Justices A. T. Lawrence and Bailhache—on May 5.

On September 4, 1914, the plaintiff, Frederick Whittaker, of Summerley Street, Earlsfield, and a friend, entered a tramcar of the London County Council in High Street, Wandsworth. Whittaker paid 1d. for his own ticket, and a halfpenny for his friend's ticket. After his friend alighted the conductor went to him, said his friend had travelled beyond the halfpenny stage, and added, "Your pal is —— tricky. There are a lot of people like you, who take halfpenny tickets and travel penny journeys." When Whittaker produced his own 1d. ticket the conductor requested him to leave the car. He refused, whereupon the conductor pushed him out, and his ankle was injured. He sued the County Council at Wandsworth County Court for damages for personal injury caused by the illegal act of their servant, the conductor. The jury found in his favour, and awarded him £30 damages, but his Honour Judge Harrington entered judgment for defendants on the ground that the act of the conductor was illegal, and would have been illegal if committed by the County Council, and that, therefore, the County Council were not liable. Plaintiff appealed from that decision.

It was argued by Mr. McCall, K.C., for the appellant, that the County Council were liable for the acts of their conductors, unless those acts were committed out of spite or to serve private ends.

Mr. Craig Henderson, for the respondents, contended that under the Tramways Act, 1870, which bound the County Council, all the conductor was entitled to do was to take name and address of a person or detain him. He had no authority to eject, except for intoxication. He could not eject a man who broke windows or fought.

Mr. Justice Lawrence, giving judgment, said a person who travelled beyond the distance for which he had paid could be ejected. If he could not be ejected the position of the authorities would be ridiculous, because they could not protect their own property. The conductor had done a wrongful act in the course of his employment, and appellant was entitled to sue. Mr. Justice Bailhache agreed. Accordingly the appeal was allowed, and judgment entered for appellant for £30 damages and costs.

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FINANCIAL REPORTS AND MEETINGS.

Provincial Tramways Company.—The directors announce an interim dividend of 8d. per share on the £1 ordinary shares, less income-tax.

India Rubber, Gutta Percha, and Telegraph Works Company has paid an interim dividend on the 5 per cent. preference shares and 2½ per cent. on the ordinary shares.

Brazilian Traction, Light and Power Company, Limited.—A dividend of 1½ per cent. for the three months ended June 30, 1915, on the 6 per cent. cumulative preference shares is announced.

Yorkshire and West Riding Electric Tramways.—The directors have decided to pay on July 1 an interim dividend of 3 per cent., being at the rate of 6 per cent. per annum on account of the dividend accrued on the 6 per cent. cumulative shares.

New General Traction Company.—The directors' report for the year ended March 31 states that the revenue received and accrued amounted to £20,358. The accounts show a profit of £11,050, to which is added £6,502 brought forward, making £17,501 available for distribution. The directors recommend that this sum should be appropriated as follows: £10,480 to the payment of a 4 per cent. dividend and £7,081 carried forward.

Wellington Tramways.—The report of the general manager of Wellington (New Zealand) Corporation Tramways for the year ended March 31 shows that the traffic receipts amounted to £155,599, an increase of £6,402. The total revenue was £167,331, an increase of £6,984, while the working expenses, at £152,014, show an increase of £6,597. The net surplus in the tramway department was £15,317, making, with the addition of £314 from the power supply, £15,631. A motor van has been purchased during the year.

Improved Position at Newport.—In their report for the year 1914-15, Newport Tramways Committee, who a year or two ago induced the Council to increase the fares, give the total income as £42,701, as compared with £41,190 for the previous year. Working expenses totalled £30,956, against £34,493, and the gross profit was £11,747, against £6,697. After paying interest and sinking fund charges there is a balance of £2,417, against a deficiency of £2,616 for the preceding year. The increase of £1,513 in the revenue was earned on a decreased car mileage of 3,629. The number of passengers showed an increase of 254,753.

Bradford Railless Traction Finances.—The results of the working of the railless trolley sections of the Bradford tramways system for the year ended March 25 last show an increase in the receipts of £2,800, due to the opening of new routes. The income for the year amounts to £4,316, which works out at slightly over 5¾d. per mile run. The expenses amount to 6¼d. per mile apart from capital charges. When interest and sinking fund are included the expenses are equal to 8d. per mile. The deficit for the year totals £1,700, as compared with £414 for the preceding year. The railless routes, however, bring a great deal of traffic to the tramways.

Rotherham Corporation Electricity and Tramways Department.—In his report to the Tramways and Electricity Committee, Mr. Cross, general manager and electrical engineer to the Rotherham Corporation, states that the tramway receipts amount to £43,834, as against £44,495 for the preceding twelve months. Notwithstanding the decrease in receipts, the gross profit is £14,201, showing an increase of £900 over last year. The total surplus, made up of the profits on tramways, trolley vehicles, and petrol 'buses, amounts to £6,644, as compared with £6,630 in the preceding period. The number of car-miles run during 1913-14 was 815,869, and the number of passengers carried was 9,828,838.

Lima Light, Power and Tramways Company.—The directors' report shows that the gross profits obtained during 1914 amounted to £p198,024, less bond service, £p60,030; interest and discount £p11,292; European expenses, £p2,692; provision for bad and doubtful debts, £p3,750; leaving a net profit of £p120,259, which with the balance brought forward, £p6,000, makes £p126,259, which the board has divided as follows in accordance with the statutes: — To reserve and redemption fund, £p28,867; to reserve for bad and doubtful debts, £p10,000; to extraordinary repairs, £p16,814; to provision for losses in exchange, £p7,000; to shareholders, 1 per cent. (in respect of the first quarter of 1914, since when no dividend has been paid), £p13,498; leaving a balance of £p50,077, which the board proposes to carry forward.

Reading Corporation Tramways.—The report of the tramways manager for the year ending March 31 shows that receipts amounted to £37,256, working expenses £20,586, leaving a gross profit, including bank interest, of £16,681. Deducting interest, sinking fund allowances, capital charges, and income tax, there remains a net balance of £4,647, from which Army allowances, amounting to £642, have to be deducted. There is, therefore, a clear balance of £4,005 available for appropriation. The mileage for the year is 924,967, and the number of passengers carried 8,881,097. The electric units consumed were 1·15 per car mile, as compared with 1·11 for the year preceding. The Tramways Committee recommended to the Council that a sum of £3,000, part of the £4,005 profit, be carried to the credit of the Borough Fund, and that the balance be carried to the credit of the reserve fund.

A Reduced Deficit at West Ham.—The accounts of the tramways for the year 1914-15 show that the deficit has been reduced from £14,421 to £5,758. The expenditure includes allowances of £6,031 to the dependents of men on active service. Attention is directed by the borough treasurer to the reserve and renewals fund, into which there appeared to have been no payment save interest since March, 1912, but which, on the other hand, had been drawn on for renewals and to meet deficit for two years. The investments at March 31, after realisations to cover the cost of renewals, stood at £15,613, and the whole of the fund had been earmarked for various purposes. The renewal fund should be approximately £67,000 or £104,000. The smaller figure was arrived at by allowing twenty years' life for the permanent way and fifteen for cars and electrical equipment; the larger by allowing fifteen years for permanent way, cars, and electrical equipment.

Shanghai Electric Construction Company.—The directors' report for 1914 states that the accounts show a profit of £33,602, which compares with £34,726 for 1913. Including £1,300 brought forward, the total standing to the credit of profit and loss account before making any appropriations was £34,903. There has been transferred to reserve for renewals account £10,000, and applied in reduction of the preliminary expenses account £1,000, and the directors recommend a dividend of 6 per cent. for the year, less income-tax, leaving to be carried forward £4,703. The loss by exchange on subsidiary coinage in 1914 was £28,038, which is equal to 8¾ per cent. on the capital of the company. Profits have been converted into sterling at an average rate of 1s. 9½d. to the Mexican dollar, as against 2s. for the preceding year. During the year the increased depreciation of subsidiary coinage and the fall in the exchange of silver into sterling combined to affect profits adversely to the extent of over £7,000.

Brisbane Electric Tramways Investment Company.—Mr H. R. Beeton, the chairman, stated, at the annual meeting held in London, that the total receipts amounted to £348,406, as compared with £316,244 for 1913, and the profit was £153,446, as against £124,308, and this, with £3,430 brought forward, gave an available balance of £156,882, of which £10,000 had been carried to the renewals fund, raising that fund to £120,000, and £144,000 had been paid in dividends, leaving £3,069 to be carried forward. The total dividend on ordinary shares was 8 per cent. for the year. The most important event had been the High Court's decision in the tramways case, which annulled the award of the Commonwealth Conciliation and Arbitration Court. Mr Badger, the manager, had been appointed managing director in Brisbane. Mr. Hamilton, K.C., mentioned that Mr. Badger had obtained a concession for tramways in Adelaide Street, which ran parallel with Queen Street, where the rails would require to be renewed within one or two years. The Adelaide Street line would be undertaken at once.

Relief Afforded to Bradford Tramways.—The financial statement of the tramways department for the year 1914-15 was presented to the Tramways Committee on May 31 by the City Treasurer, and it showed a net profit of £32,500, as compared with £29,500 for the preceding year. The total income is £305,000, or £8,000 more than last year, representing 11¾d. per car-mile, as compared with 11½d. The expenditure includes £2,800, allowances to dependents of men serving in the Forces. Rates and taxes have been reduced by £2,000 owing to re-assessment consequent upon the diminished profits of the past two years. Relief has also been afforded to the extent of £6,000 by a new method instituted in connection with the sinking fund arrangements. The Finance Committee decided in regard to the trading undertakings sinking fund that instead of setting aside an equal fractional part represented by the number of years authorised for repayment of the loan, such a sum is to be set aside as, with compound interest, would accumulate to the amount of the loan at the end of the period. The parcels department gave a profit of £1,070. The amount expended on track renewals was £22,300. The reserve and renewals fund now totals £75,208. A sum of £440,000 has been repaid of the capital expenditure of £1,052,000.

Financial Effect of London Tramway Strike.—The effect of the strike of the employees of the London County Council Tramways on the tramway revenue is shown by the traffic returns for the weeks ended May 19, 26, and June 2, all of which have been issued this week. The figures are as follows: —

	1914.	1915.	Decrease.
Week ended May 19 ...	£44,961	£22,460	£22,501
Week ended May 26 ...	43,762	12,610	31,152
Week ended June 2 ...	47,346	23,586	23,760
Week ended June 9 ...	42,788	41,087	1,701

The receipts up to the week ended June 9 this year amounted to £390,954. Compared with the corresponding ten weeks of last year there is a decrease of £46,987. Owing to the strike there was practically no tramway service on Whit-Monday, but in view of the with-

(*Continued on page* 43.)

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Year Ended.	Electric Traction Inaugurated.	System.	Line open (single track). Mls. Chs.	Borrowing Powers.	Borrowing Powers Exercised.	Unexhausted Borrowing Powers.	Total Capital Expenditure.	Capital Expenditure per Mile of Single Track.	Loans Outstanding.	Loans Repaid and Sinking Fund.	Depreciation, Renewal and Reserve Funds.	Gross Receipts. Traffic.	Other.	Total.
Aberdeen ...	May 31, 1914	Dec., 1899	E.	27 72	415,000	357,191	57,809	357,191	12,802	186,885	246,163	169,987	84,276	991	85,267
Accrington ...	Mar. 31, 1914	Aug., 1907	,,	10 53	181,925	133,875	48,050	134,734	12,636	113,870	20,864	16,581	29,843	350	30,193
Ashton-u-Lyne..	Mar. 25, 1914	Aug., 1902	...	8 15	130,070	109,814	20,256	109,814	13,412	73,958	32,270	2,950	23,341	677	24,019
Ayr	May 15, 1914	Sept., 1901	,,	9 30	128,000	98,630	29,369	100,841	10,756	79,171	19,460	16,489	18,315	1,062	19,377
Birmingham ...	Mar. 31, 1914	Jan., 1904	,,	114 44	2,577,611	2,352,104	225,507	2,334,437	20,379	1,913,559	438,545	186,154	628,016	7,455	635,471
Blackburn ...	Mar. 25. 1915	Mar., 1899	,,	24 63	408,174	342,474	65,700	336,258	13,566	354,600	191,985	3,718	65,158	3,144	68,302
Blackpool ...	Mar. 31, 1914	June, 1899	,,	(p)21 33	453,798	310,994	142,804	310,994	14,524	310,994	126,036	21,660	84,034	763	84,797
Bolton	Mar. 31, 1914	Dec., 1899	,,	47 19	551,092	551,092	...	566,395	11,961	399,417	178,850	50,819	142,504	1,270	143,774
Bradford ...	Mar. 31, 1914	July, 1898	,,	(h)106 29	1,280,788	1,061,113	219,675	1,040,118	9,779	653,504	420,844	82,898	298,525	18,608	317,133
Brighton	Mar. 31, 1914	Nov., 1901	,,	17 15	378,093	277,905	100,188	278,467	16,202	219,972	62,273	5,841	54,600	2,238	56,838
Burnley	Mar. 31, 1914	Dec., 1901	,,	22 18	388,052	325,999	62,053	232,501	10,461	179,136	64,381	39,684	88,050	266	88,316
Burton-on-Trent	Mar. 31, 1914	Aug., 1903	,,	10 50	108,632	104,562	4,070	106,275	10,121	49,239	55,323	10,134	15,010	1,497	16,507
Bury	Mar. 31, 1915	June, 1903	,,	(b)36 10	407,800	284,745	123,055	293,237	12,826	254,832	55,416	33,960	68,740	276	69,016
Chester	Mar. 25, 1914	April, 1903	,,	6 35	92,991	82,380	10,611	82,934	12,883	68,477	14,121	4,282	12,793	480	13,273
Chesterfield ...	Mar. 31, 1914	Dec., 1904	,,	5 8	98,000	73,500	24,500	69,810	13,663	57,660	13,820	6,307	13,608	465	14,073
Colchester ...	Mar. 31, 1914	July, 1904	,,	7 75	70,748	69,555	1,193	69,401	8,743	50,816	19,483	Nil.	10,390	509	10,899
Croydon	Mar. 31, 1914	(q) Sept., 1901	,,	17 50	287,689	287,689	Nil	284,847	16,162	229,300	96,719	42,352	84,926	2,100	87,026
Darlington ...	Mar. 31, 1914	June, 1904	,,	8 71	107,500	77,832	29,668	77,786	8,752	56,178	23,338	6,806	12,976	261	13,237
Darwen	Mar. 31, 1914	Oct., 1900	,,	7 13	93,400	86,300	7,100	85,831	11,984	55,090	30,892	8,500	15,631	1,003	16,634
Derby	Mar. 31, 1914	July, 1904	E.	22 20	239,980	239,980	...	245,332	11,026	177,676	67,656	(l) 32,356	E 51,126	1,048	52,174
			H.		...	...	...	...	...	...	...	...	H 429	19	448
Doncaster ...	Mar. 31, 1914	June, 1902	E.	12 58	...	...	...	107,921	8,481	94,700	16,581	1,442	22,890	318	23,208
Dundee	May 15, 1914	July, 1900	,,	28 32	(f)	354,783	...	362,116	12,751	264,720	90,062	82,966	67,754	1,750	69,504
East Ham ...	Mar. 31. 1914	June, 1901	,,	14 5	190,643	190,242	401	191,654	13,127	140,457	65,478	5,453	54,079	836	54,915
Exeter	Mar. 31, 1914	April, 1905	,,	7 0	106,000	86,111	19,889	86,111	12,301	67,354	19,249	6,290	17,489	97	17,586
Gloucester ...	Mar 31. 1914	April, 1904	,,	15 1	191,000	144,333	46,667	147,783	9,846	107,275	20,592	1,000	16,829	1,188	18,017
Halifax	Mar. 31, 1914	June, 1898	,,	55 39	449,263	417,466	31,797	419,335	7,557	297,327	119,433	31,745	108,617	1,033	109,650
Ilford	Mar. 31, 1914	Mar., 1903	,,	11 28	149,633	149,633	Nil	149,574	13,178	104,842	44,791	2,297	23,485	2,308	25,793
Ilkeston	Mar. 31, 1914	May, 1903	,,	3 56	64,214	47,000	17,214	47,833	13,436	31,462	16,422	...	6,915	171	7,086
Ipswich	Mar. 31, 1914	Nov., 1903	,,	14 70	116,471	114,300	2,171	115,676	7,776	96,912	18,447	11,994	22,964	862	23,826
Keighley	Mar. 31, 1913	Oct., 1904	,,	6 9	50,934	47,328	3,606	47,328	7,743	32,468	16,961	942	8,845	313	9,158
Kilmarnock ...	May 15. 1914	Dec., 1904	,,	5 47	65,000	52,795	12,205	53,281	9,536	47,250	8,707	5,298	9,088	265	9,353
Kirkcaldy ...	May 15. 1914	Feb., 1903	,,	8 65	213,000	96,749	116,251	96,749	10,979	77,868	18,881	4,687	17,506	443	17,949
Lancaster ...	Mar. 31, 1914	Jan., 1903	,,	4 65	...	45,700	...	43,684	9,077	30,450	15,350	3,074	5,779	158	5,937
Leith	May 15, 1914	Aug., 1905	,,	17 73	275,000	238,000	37,000	236,877	13,211	179,350	58,650	3,045	36,555	1,170	37,725
Leyton	Mar. 31, 1914	Dec., 1906	,,	18 8	324,201	324,145	56	295,376	16,319	240,741	57,244	2,654	69,148	1,541	70,689
Lincoln	Mar. 31, 1914	Nov., 1905	S.	2 77	98,519	44,947	53,572	44,987	15,185	41,579	11,176	(l) 1,100	6,971	130	7,101
Liverpool ...	Dec. 31, 1914	Nov., 1898	E.	124 0	2,622,786	2,057,850	564,936	2,062,391	16,741	1,168,685	1,177,949	366,545	684,026	13,050	697,076
Lowestoft ...	Sep. 30, 1914	July, 1903	,,	4 6	96,230	91,178	5,052	91,178	22,375	75,480	17,614	Nil	11,357	373	11,730
Maidstone ...	Mar. 31. 1914	July, 1904	,,	7 3	82,932	82,932	...	79,098	11,239	65,574	17,358	...	10,391	575	10,966
Manchester ...	Mar. 31, 1914	June, 1901	,,	202 48	2,358,606	2,117,411	141,195	2,130,904	10,518	1,616,131	491,410	478,381	911,223	14,087	925,310
Nelson	Mar. 31, 1914	Feb.. 1903	,,	3 69	38,000	37,885	115	37,885	9,808	29,145	8,740	...	10,801	52	10,853
Newport (Mon.) .	Mar. 31, 1914	April, 1903	,,	14 28	219,250	196,250	23,000	194,983	13,588	159,734	45,350	4,055	40,151	1,039	41,190
Nottingham ...	Mar. 31, 1915	Jan., 1901	,,	44 20	...	...	...	733,674	16,586	473,999	261,364	56,626	176,289	3,026	179,315
Oldham	Mar. 25, 1914	May, 1902	,,	28 6	509,723	442,047	67,676	444,565	15,835	311,148	133,167	8,455	114,481	1,689	116,170
				(b) 8 31											
Perth	May 15, 1913	Nov., 1905	,,	6 60	90,000	78,350	11,650	78,629	11,649	63,340	15,489	1,673	8,761	509	9,270
Plymouth ...	Mar. 31, 1914	Sept., 1899	,,	15 0	182,856	181,479	1,377	219,417	14,628	86,903	89,493	24,252	39,989	891	40,880
Pontypridd ...	Mar. 31, 1913	Mar., 1905	,,	8 48	136,019	135,919	100	137,148	15,946	109,757	26,052	Nil	21,580	313	21,893
Rawtenstall ...	Mar. 31, 1914	May, 1909	,,	15 71	193,290	182,168	11,122	182,273	11,473	156,813	25,355	3,870	26,873	369	27,242
Rochdale	Mar. 31, 1914	May, 1902	,,	(i)40 2	356.991	347,782	9,209	353,066	16,020	347,782	95,573	11,000	82,878	298	83,176
Rotherham ...	Mar. 31, 1914	Jan., 1903	,,	12 2	342,200	183,775	158,325	184,859	14,537	152,244	33,481	24,632	44,495	70	44,565
			R.T	...	...	...	...	...	...	...	...	...	5,757	...	5,767
Salford	Mar. 31, 1914	Oct., 1901	E.	75 64	1,050,666	724,469	326,197	723,923	9,554	532,821	191,648	28,492	272,758	54	272,812
Southampton ...	Mar. 31, 1914	Jan., 1900	,,	18 54	277,241	261,219	16,022	258,299	13,831	164,454	89,483	13,433	67,672	2,926	70,598
Southend-on-Sea	Mar. 31, 1913	July, 1901	,,	11 49	130,000	129,961	39	143,808	12,384	116,940	12,784	3,045	34,453	465	34,918
Southport ..	Mar. 31, 1914	July, 1900	,,	(d) 10 63	294,000	197,730	94,270	196,178	9,921	150,250	47,480	442	18,391	455	18,846
South Shields ...	Mar. 31, 1914	Mar., 1906	,,	10 21	251,882	175,056	76,826	173,599	16,916	146,912	33,413	(l) 26,881	37,744	586	38,330
Sialy'ge, H., M., D.	Mar 31, 1914	May, 1904	,,	27 57	325,270	274,990	44,280	279,778	10,096	217,173	63,817	811	40,333	292	40,625
Stockport ...	Mar. 31, 1914	Aug., 1901	,,	27 5	318,847	234,500	84,347	251,514	9,294	158,391	76,109	37,179	66,715	1,322	68,037
Sunderland ...	Mar. 31, 1914	Aug., 1900	,,	20 28	308,699	303,211	5,488	305,493	15,012	172,370	121,890	39,508	74,861	365	75,226
Wallasey ...	Mar. 31, 1914	Mar., 1902	,,	19 77	198,867	195,290	3,577	216,498	10,848	161,934	64,221	9,520	63,151	562	63,713
Walsall	Dec. 31. 1914	Dec., 1902	,,	19 44	188,145	188,100	45	182,926	9,357	154,044	63,649	34,960	33,311	778	34,089
Walthamstow ...	Mar 31, 1914	June, 1905	,,	13 30	198,000	194,000	4,000	188,192	14,070	171,716	21,781	1,940	38,590	718	39,308
Warrington ...	Mar. 31, 1914	April, 1902	,,	9 52	103,674	102,896	778	102,128	10,583	70,476	32,422	10,000	23,232	521	23,753
West Ham ...	Mar. 31, 1914	Feb., 1904	,,	30 4	563,478	551,588	11,890	556,878	18,532	527,934	104,716	32,740	142,034	3,155	145,189
Wigan	Mar. 31, 1914	April, 1901	,,	30 73	500,955	483,757	17,198	473,906	15,349	392,118	142,815	804	77,973	1,375	79,348
Wolverhampton	Mar. 31, 1914	April, 1902	S.	21 40	279,733	268,185	11,548	287,569	13,378	215,166	61,351	54,864	56,444	759	57,203
Yarmouth (Gt.).	Mar. 31, 1914	June, 1902	E.	14 58	149,600	124,750	24,850	126,363	9,207	116,450	25,996	9,075	25,712	527	26,239
York	Mar. 31, 1914	Jan., 1910	,,	12 20	157,150	157,150	340	156,810	12,853	152,470	6,323	5,092	26,133	642	26,775

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	Mar. 31, 1914	Nov., 1905	E.	98 54	1,528.146	1,381,200	146,946	1,440,959	14,565	1,343,000	224,840	97,783	268,250	3,812	272,062
Bexley	Mar. 31, 1914	Oct., 1903	,,	6 42	100,798	98,812	1,986	98,408	15,376	75,408	23,403	942	14,698	1,649	16,346
Birkenhead	Mar. 31, 1914	Feb., 1901	,,	24 7	376,398	369,528	6,870	371,097	15,406	239,201	130,267	22,655	67,725	4,300	72,025
Bournemouth ...	Mar. 31, 1914	July, 1902	,,	(e) 29 62	471,850	432,440	39,410	443,006	19,821	286,385	146,054	18,409	104,353	616	104,969
Cardiff	Mar. 31, 1914	May, 1902	,,	31 66	830,382	787.292	43,090	786,510	24,714	514,059	273,232	104,002	141,519	24,681	166,200
Coventry ...	Mar. 31. 1914	Jan.. 1912	,,	15 61	251,014	235.574	15,440	229,197	14,541	230,596	8,517	3,983	42,751	733	43,484
Glasgow	May 31, 1914	Oct., 1898	,,	193 40	3,714,266	3,694,143	20,123	3,675,317	19,023	2,517,360	1,176,783	2,196,808	1,078,691	5,156	1,083,847
				(b) 2 53											
Huddersfield ...	Mar. 31. 1914	Feb., 1901	,,	48 41	772,662	407,142	365,520	458,878	9,460	239,984	176,542	30,974	112,660	3,660	116,320
Hull	Mar. 31, 1914	July, 1899	,,	33 12	645,073	565,998	79,075	566,754	17,096	552,191	164,991	137,060	165,892	1,074	166,966
Leeds	Mar. 31, 1914	Aug., 1897	,,	114 5	1,701,455	1,626,422	75,033	1,571,196	14,384	1,286,916	534,631	4,801	423,516	3,939	427,455
Leicester	Dec. 31, 1914	May, 1904	,,	37 0	1,006,946	818,073	138,290	828,953	22,404	674,936	147,944	91,843	149,664	20,571	170,235
London	Mar. 31, 1914	...	H.	13 73				...	...	...	...	...	21,145	480	21,635
		May, 1903	C.E	277 26	(c)	(c)	(c)	13,028,119	...	9,923,528	3,370,966	730,346	2,181,344	65,698	2,247,042
N'castle-on-Tyne	Mar. 31. 1914	Dec., 1901	E.	62 72	1,522,010	1,277,747	244,263	1,284,380	20,428	929,766	428,119	94,337	251,024	10,177	261,201
Northampton ...	Mar. 31, 1914	July, 1904	,,	9 16	239,800	127,255	112,545	126,431	13,742	87,022	40,501	11,834	28,527	812	29,339
Portsmouth ...	Mar. 31. 1914	Sep., 1901	,,	34 51	708,618	708,618	...	772,684	22,308	449,206	259,413	75,054	115,168	1,823	116,991
Preston	Mar. 31, 1914	June, 1904	,,	17 16	224,102	187,269	36,833	187,269	10,888	117,315	47,130	39,392	45,618	328	45,946
Reading	Mar. 31, 1914	July, 1903	,,	13 14	235,000	234,000	1,000	230,763	17,515	162,634	68,159	18,371	35,282	1,043	36,325
Sheffield	Mar. 25, 1914	Sep.. 1899	,,	79 3	1.640.371	1.426.217	214,154	1,521,439	19,250	1,073.612	463,575	30,378	386.114	3.562	389,676
Wellington, N.Z.	Mar. 31, 1914	...	,,	31 55	496.423	496.423	...	628.151	19.821	496.423	46.836	120.191	157.096	1,161	158.257

C—Electric conduit system. E—Electric trolley system. H—Horse lines RT—Railless trolley system. S—Surface contact system.
(b) Includes 18 miles 21 chains leased lines. (c) Conferred by Annual Money Act, which limits amount for each financial year. Powers not exercised are lapsed.
(d) Not including 8 m. 78 ch. leased lines. (e) Includes 7 mi. 34 chs. leased lines. (f) Unlimited. (h) Includes 1½ miles railless trolley route. (i) 17 mi. 8 chn. single track leased.
(k) Not including 10 miles 3 chains single track lines leased. (l) Including Insurance. (p) Including leased lines. (q) Corporation working commenced June, 1906.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Working Expenses.					Gross Profit on Working.	Additions to Gross Profit	Deductions from Gross Profit.						Net Surplus + or Deficit −
	Traffic.	General.	Repairs & Maintenance.	Power.	Total.			Interest.	Sinking Fund.	Income Tax.	Depreciation & Renewal	Sundries.	Total.	
Aberdeen	22,265	10,290	7,180	7,301	47,036	38,231	1,102	6,701	4,897	...	14,533	213	26,344	+ 12,989
Accrington	7,570	2,792	2,268	4,880	17,510	12,683	...	3,969	3,783	198	3,100	65	11,115	+ 1,568
Ashton-under-Lyne	5,149	1,682	3,053	3,372	13,256	10,763	...	2,590	3,760	477	800	39	7,666	+ 3,097
Ayr	4,206	2,093	1,905	2,457	10,661	8,716	...	(h) 2,558	1,744	164	2,503	606	7,575	+ 1,141
Birmingham	183,119	59,947	88,698	113,743	445,507	189,964	8,487	68,478	53,804	...	...	197	122,479	+ 75,972
Blackburn	16,859	6,197	14,451	9,421	46,928	21,374	287	(h) 4,388	15,450	251	1,572	...	21,661	...
Blackpool	16,643	6,851	9,719	10,273	43,486	41,311	...	(h) 9,429	7,329	...	10,000	...	26,758	+ 14,553
Bolton	30,721	9,423	16,898	20,151	77,193	66,581	995	h) 11,230	17,387	1,239	18,357	1,446	49,659	+ 17,917
Bradford	92,305	29,243	58,991	50,611	231,150	85,983	3,877	20,443	31,822	3,888	11,454	5,053	72,660	+ 17,200
Brighton	14,691	4,716	14,420	8,613	42,440	14,398	122	7,895	5,783	...	...	...	13,678	+ 842
Burnley	23,284	7,571	11,998	20,096	62,949	25,367	...	6,939	7,728	1,072	...	(f) 1,941	17,680	+ 7,687
Burton-on-Trent	5,442	1,502	2,562	3,154	12,660	3,847	(q) 1,524	1,364	1,344	...	1,500	...	4,208	+ 1,163
Bury	16,129	4,971	7,162	7,504	35,766	33,250	303	(h) 7,037	6,026	825	2,472	(w) 11,193	27,553	+ 6,000
Chester	3,290	1,534	1,208	2,096	8,128	5,145	158	(h) 2,754	1,018	..	...	...	3,772	+ 1,531
Chesterfield	3,214	1,368	2,936	2,192	9,710	4,363	269	2,275	1,900	...	...	...	4,175	+ 457
Colchester	2,783	1,286	2,177	2,566	8,812	2,087	67	2,081	2,406	...	...	...	4,487	− 2,333
Croydon	29,938	6,976	14,626	18,203	69,743	17,283	664	7,943	7,415	1,227	...	1,132	17,717	+ 230
Darlington	4,305	812	1,995	2,012	9,124	4,113	101	(h) 1,944	1,996	102	469	...	4,511	− 297
Darwen	3,980	1,018	3,287	2,569	10,854	5,780	156	2,247	2,190	...	1,050	...	5,487	+ 449
Derby	E 17,320 H 540	2,906 ...	5,499 81	8,610 ...	34,335 621	17,839 def. 173	239	6,236	3,464	...	5,536	(l) 185	15,421	+ 2,657
Doncaster	4,969	1,342	6,550	4,166	17,027	6,181	16	2,935	1,840	138	572	58	5,543	+ 654
Dundee	17,495	5,964	9,477	10,502	43,438	26,066	...	8,742	6,400	211	9,701	...	25,054	+ 1,012
East Ham	18,739	6,802	12,067	10,521	48,129	6,786	...	(h) 5,570	6,882	...	...	573	13,025	− 6,239
Exeter	4,888	1,373	1,483	3,827	11,571	6,015	...	(h) 2,305	1,885	101	...	...	4,291	+ 1,724
Gloucester	7,027	1,703	3,226	1,925	13,881	4,136	...	(h) 5,325	1,980	95	250	...	7,650	− 3,514
Halifax	29,239	7,803	15,805	20,426	73,273	36,377	...	10,288	11,617	...	56	773	22,734	+ 13,643
Ilford	9,916	2,431	3,740	4,791	20,878	4,915	557	3,969	5,070	...	...	...	9,039	− 3,567
Ilkeston	2,262	789	1,378	1,460	5,889	1,197	160	1,450	1,532	90	...	96	3,168	− 1,811
Ipswich	8,538	2,250	5,578	3,522	19,888	3,938	...	(h) 3,624	2,142	...	...	...	5,766	− 1,828
Keighley	2,692	768	899	1,612	5,971	3,187	179	1,116	1,881	...	...	(n) 369	3,366	...
Kilmarnock	3,195	746	1,327	1,717	6,985	2,368	...	1,628	1,252	...	1,160	...	4,040	− 1,672
Kirkcaldy	4,942	1,424	2,007	3,081	11,454	6,495	...	2,656	2,355	...	410	233	5,654	+ 841
Lancaster	2,290	522	841	1,594	5,247	690	52	1,158	1,511	...	...	...	2,669	− 1,927
Leith	9,742	3,131	5,080	3,920	21,873	15,852	242	(h) 6,211	7,850	...	2,274	67	16,402	− 308
Leyton	p) 22,360	8,611	13,711	12,923	57,605	13,084	133	10,007	8,461	...	...	202	18,670	− 5,453
Lincoln	1,473	644	973	960	4,050	3,051	402	1,529	1,071	...	...	...	2,600	+ 853
Liverpool	192,352	69,830	83,100	123,527	468,809	228,267	25,231	50,082	63,726	...	(d) 34,821	(e) 4,869	153,498	+ 100,000
Lowestoft	3,405	655	1,552	2,323	7,935	3,795	..	2,441	2,251	...	...	...	4,692	− 897
Maidstone	2,609	1,062	1,686	1,934	7,291	3,675	57	2,470	1,969	...	...	114	4,553	− 821
Manchester	276,663	89,420	89,649	129,492	585,224	340,086	13,594	(h) 55,729	54,599	9,418	97,219	33,625	250,590	+ 103,090
Nelson	2,537	684	1,525	2,123	6,869	3,984	...	978	1,026	...	...	...	2,004	+ 1,980
Newport (Mon.)	10,513	4,240	13,070	6,670	34,493	6,697	925	5,850	4,231	...	...	158	10,239	− 2,617
Nottingham	48,272	14,674	17,408	30,692	111,046	68,269	...	16,444	21,121	...	...	(i) 2,040	39,605	+ 28,664
Oldham	26,908	8,585	22,246	20,564	78,303	37,867	1,317	15,559	11,718	1,352	...	(g) 5,654	34,283	+ 4,901
Perth	3,182	698	418	1,252	5,550	3,720	50	1,523	1,632	3	612	...	3,770	...
Plymouth	8,430	3,896	4,514	8,026	24,866	16,014	1,257	4,282	3,141	690	5,121	...	13,234	+ 4,037
Pontypridd	5,017	1,395	5,476	3,196	15,084	6,809	1,754	(h) 4,009	4,160	...	...	39	8,208	+ 355
Rawtenstall	5,877	2,966	3,130	4,304	16,277	10,965	3,422	5,626	6,280	...	...	1,860	13,766	+ 621
Rochdale	18,788	5,167	9,525	10,949	44,429	38,747	1,397	11,485	9,594	1,020	...	(z) 9,555	31,654	+ 8,490
Rotherham	E 10,374 RTI, 310	3,084 409	7,888 1,434	9,918 658	31,264 3,811	13,301 1,946	209 31	5,008 400	3,465 568	... ...	... ...	... ...	8,473 968	+ 5,037 + 1,009
Salford	79,460	23,804	25,203	50,303	178,770	94,042	5,044	(h) 17,392	22,470	2,760	5,674	(k) 28,790	77,086	+ 22,000
Southampton	19,977	5,011	9,212	12,321	46,521	24,077	180	7,333	7,433	554	...	...	15,320	+ 8,937
Southend-on-Sea	8,046	2,260	3,534	6,187	20,027	14,891	4,228	(h) 3,834	1,753	...	4,017	...	9,605	+ 9,514
Southport	4,754	2,126	3,103	2,999	12,982	5,864	6,379	6,516	5,018	...	2,144	...	13,678	− 1,435
South Shields	8,838	3,715	3,633	6,399	22,585	15,745	265	(h) 5,333	3,570	...	...	...	8,903	+ 7,107
Staly'dge, H., M., D.	13,073	4,883	6,163	6,724	30,843	9,782	...	(h) 7,093	7,527	...	311	721	15,652	− 5,870
Stockport	14,828	4,583	10,045	5,964	35,420	32,617	1,170	5,432	8,909	1,163	2,369	(j) 3,414	21,287	+ 12,500
Sunderland	19,609	5,294	6,482	11,276	42,661	32,565	259	(h) 6,837	9,948	637	10,002	400	27,824	+ 5,000
Wallasey	17,686	4,792	6,512	11,500	40,490	23,223	92	5,603	4,885	...	...	634	11,122	+ 12,193
Walsall	8,510	3,326	4,315	5,670	21,821	12,268	1,339	4,962	3,975	551	640	...	10,128	+ 3,479
Walthamstow	14,821	3,234	7,416	8,568	34,039	5,269	301	h) 6,396	3,265	...	3,645	...	13,306	− 7,736
Warrington	5,939	1,834	3,973	3,411	15,217	8,536	537	2,481	3,353	...	...	...	5,834	+ 3,239
West Ham	53,477	18,084	33,440	21,174	126,175	19,014	...	20,056	12,398	692	...	290	33,436	− 14,422
Wigan	16,604	5,226	11,643	11,016	44,489	34,859	308	14,197	12,561	...	...	(e) 3,719	30,477	+ 4,690
Wolverhampton	12,793	5,177	7,620	7,536	33,126	24,077	(x) 1,305	7,793	5,285	187	6,564	...	19,829	+ 5,553
Yarmouth (Gt.)	7,756	1,849	3,052	4,951	17,608	8,631	75	(h) 4,065	2,826	...	1,815	...	8,706	...
York	8,713	2,028	1,936	5,259	17,936	8,839	...	(h) 4,609	1,706	...	...	...	6,315	+ 2,524

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	77,949	12,593	41,455	28,281	160,278	111,784	931	48,342	31,353	1,072	17,000	3,082	100,849	+ 11,866
Bexley	3,282	1,382	*3,554	828	(a) 11,630	4,716	...	2,794	2,509	...	324	...	5,627	− 911
Birkenhead	17,015	5,374	11,759	10,744	44,892	27,133	83	(h) 11,577	9,499	373	5,712	55	27,216	...
Bournemouth	24,154	8,350	10,307	16,200	59,011	45,958	2,550	(h) 10,265	15,255	...	12,871	(c) 8,117	46,508	+ 2,000
Cardiff	44,037	11,121	18,146	26,260	99,564	66,636	2,592	23,941	23,014	2,835	6,946	...	56,736	+ 12,492
Coventry	12,861	4,471	7,945	3,839	29,116	14,368	478	8,506	5,230	...	277	414	14,427	+ 419
Glasgow	332,546	134,034	156,214	53,483	676,277	407,570	64,989	82,921	102,607	14,057	212,642	6,440	418,667	+ 53,892
Huddersfield	28,548	6,253	27,821	8,349	70,971	45,349	519	(h) 11,617	11,004	1,545	...	406	24,572	+ 21,296
Hull	50,246	14,935	41,885	11,803	118,869	48,097	879	16,953	12,954	1,425	3,374	...	34,706	+ 14,270
Leeds	113,819	41,144	41,020	30,399	226,382	201,073	8,354	44,961	53,914	5,344	31,576	3,627	139,422	+ 70,005
Leicester	59,052	11,397	22,836	25,322	118,607	51,628	1,660	24,218	13,764	2,801	10,741	1,284	52,808	+ 480
London	H 10,806 E 809,987	3,679 (r) 183,797	4,059 345,138	m) 11,671 246,328	30,215 1,585,251	def. 8,590 661,791	... 34,032	328,109	408,488	28,197	1,476	(l) 18,079	784,349	− 88,826
N'castle-on-Tyne	71,892	25,519	27,150	22,991	147,552	113,649	4,086	(h) 31,257	41,450	3,618	...	2,805	79,130	+ 38,605
Northampton	7,881	3,169	2,806	4,958	18,814	10,525	506	(h) 3,322	4,422	309	195	b) 1,083	9,331	+ 1,700
Portsmouth	31,669	11,041	8,901	6,009	57,620	59,371	(a) 12,203	21,593	18,263	1,302	11,714	...	52,872	+ 18,702
Preston	12,350	4,989	9,252	2,995	29,586	16,360	...	3,625	5,038	...	...	1,356	10,019	+ 6,341
Reading	8,635	3,661	4,086	3,597	19,979	16,346	...	6,716	5,062	149	...	...	11,927	+ 4,419
Sheffield	121,630	27,956	48,047	35,128	232,761	156,915	2,821	35,305	43,518	3,306	30,123	7,871	120,123	+ 39,613
Wellington, N.Z.	57,973	7,775	21,918	17,947	105,613	52,644	2,091	19,865	4,757	...	14,682	...	39,304	+ 15,431

(a) Includes £11,374 balance forward from previous year. (b) Includes £311 loss on omnibus account. (c) Includes £1,611 insurance fund.
(d) Includes reserve. (e) Includes rents for leased lines. (f) Rent of leased lines. (g) Rent of lines and deficit on motor omnibus account.
(h) Including income tax. (i) Includes Army Service Allowance. (j) Includes £692 deficit on railless traction. (k) Includes rents of lines. (l) Including loss on horse traction. (m) Horsing expenses. (n) Transferred to motor omnibus capital account. (o) Includes £1,837 through-running contributions. (p) Includes £407 horse account. (r) Including special charges, £6,053. (s) Includes £2,584 through-running contributions to L.C.C. (w) Amount apportioned to leased lines.
(x) Includes £365 profit motor char-a-banc. (z) Includes £6,519 rent of leased lines. ‡ £2,950 profit from 3 months' working.
* Includes £1,913 spent on renewals.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Appropriation of Net Surplus.			Receipts per Car Mile.		Operating Expenses per Car Mile.					Percentage of Operating Expenses to Total Revenue.	Average Operating Expenses per Car Mile (excludi'g Power Cost).	Board of Trade Units.		
	Carried Forward.	Reserve.	Contribution to Rates or Municip'l Funds.	Average Total per Car Mile.	Average Traffic per Car Mile.	Traffic.	General.	Repairs and Maintenance.	Power. (Price paid)	Total.			Units.	Cost per Unit.	Units used per car mile.
				d.	d.	d.	d.	d.	d.	d.	%	d.		d.	
Aberdeen ...	...	12,989	...	11·17	11·04	2·916	1·348	·940	·956	6·16	55·16	5·415	2,170,033	·80	1·184
Accrington ...	...	...	1,568	12·64	12·49	3·17	1·18	·94	2·04	7·33	57·99	5·29	949,054	1·23	1·65
Ashton-u-Lyne	47	...	3,050	12·4197	12·0692	2·6622	·8695	1·5788	1·7434	6·8539	55·19	5·1105	640,413	1·25	1·38
Ayr...	...	1,141	...	10·45	9·88	2·26	1·12	1·02	1·32	5·75	55	4·42	421,844	1·39	·94
Birmingham ...	...	31,000	44,972	10·689	10·564	3·080	1·009	1·492	1·913	7·494	70	5·581	24,257,823	1·125	1·70
Blackburn ...	...	...	...	13·81	13·71	3·40	1·25	2·92	1·91	9·48	68·70	7·57	1,739,274	1·3	1·54
Blackpool ...	...	2,553	12,000	18·91	18·74	3·71	1·52	2·17	2·29	9·69	51·28	7·40	1,506,323	1·63	1·40
Bolton	417	...	17,500	11·944	11·838	2·552	·782	1·404	1·674	6·412	53·064	4·664	4,396,543	1·1	1·52
Bradford	...	...	17,200	12·166	11·486	3·204	1·051	2·173	1·948	8·376	73·138	6·428	12,041,279	1	1·924
Brighton	842	...	...	11·794	11·33	3·049	·978	2·992	1·787	8·806	74·66	7·02	1,722,548	1·2	1·49
Burnley	...	...	7,687	12·079	12·043	3·185	1·035	1·640	2·749	8·609	71·37	5·86	3,894,011	1·24	2·22
Burton-on-Trent	1,163	...	...	9·02	8·28	2·97	·82	1·40	1·72	6·91	76·7	5·08	545,672	1·39	1·08
Bury	...	(k)1,000	5,000	10·26	10·22	2·399	·776	1·253	1·268	5·696	51·82	4·428	2,045,692	1·25	1·26
Chester	...	1,531	...	9·17	8·84	2·27	1·06	·83	1·45	5·61	61	4·17	378,158	1·33	1·08
Chesterfield ...	...	457	...	11·1	10·8	2·54	1·08	2·31	1·73	7·66	68·9	5·93	420,824	1·25	1·38
Colchester ...	...	...	...	8·058	7·682	2·058	·95	1·61	1·897	6·515	80·36	4·618	410,555	1·5	1·26
Croydon	...	230	...	7·464	7·284	2·568	·599	1·254	1·561	5·982	79·53	4·42	2,874,462	1·522	1·027
Darlington ...	...	...	...	8·230	8·068	2·676	·505	1·241	1·251	5·673	68·93	4·422	482,791	1	1·25
Darwen	445	...	...	14·96	14·09	3·20	·92	2·96	2·31	9·39	65·25	7·08	469,939	1·312	1·77
Derby	(n) 75	...	...	E 10·358	10·150	3·438	·577	1·092	1·709	6·816	65·8	5·107	1,425,112	1·45	1·179
				H. 6·077	5·821	7·325	...	1·099	...	8·424	138·6	...	...	...	...
Doncaster ...	...	654	...	10·52	10·37	2·24	·61	2·97	1·90	7·72	73·1	5·82	799,965	1·25	1·51
Dundee	...	12	1,000	12·018	11·716	3·026	1·031	1·639	1·815	7·511	62·49	5·696	2,520,470	1	1·815
East Ham ...	...	...	...	8·73	8·59	2·98	1·08	1·92	1·67	7·65	87·60	5·98	2,385,535	1·062	1·58
Exeter	...	1,724	...	9·456	9·404	2·628	·738	·797	2·059	6·222	65·8	4·163	565,247	1·625	1·27
Gloucester ...	...	...	...	6·77	6·32	2·64	·64	1·21	·72	5·21	77	4·49	481,967	1	·72
Halifax	1,818	5,792	6,033	11·738	11·627	3·130	·836	1·692	2·186	7·844	67	5·66	4,357,466	1·125	1·94
Ilford	...	...	...	6·891	6·768	2·862	·688	1 048	1·278	5·877	80·9	4·598	1,079,384	1·065	1·175
Ilkeston	...	...	...	7·04	6·87	2·3	·8	1·3	1·4	5·8	83	4·4	372,200	1	1·54
Ipswich	...	...	...	8·552	8·242	3·065	·807	2·002	1·265	7·139	83·47	5·874	676,189	1·25	1·011
Keighley	...	...	...	9·064	8·754	2·664	·761	·890	1·595	5·910	65	4·315	254,636	1·5	1·05
Kilmarnock ...	...	...	...	7·539	7·326	2·57	·61	1·07	1·38	5·63	74·6	4·246	329,577	1·25	1·14
Kirkcaldy ...	341	...	500	9·162	8·936	2·522	·727	1·024	1·573	5·846	65·43	4·273	739,564	1	1·573
Lancaster ...	...	...	...	8·23	7·94	3·14	·71	1·16	2·19	7·20	88	5·02	225,094	1·7	1·29
Leith	...	...	...	9·54	9·24	2·46	·79	1·29	·99	5·53	57·98	4·54	939,737	1·001	·99
Leyton	...	...	...	9·355	9·151	(c) 2·959	1·140	1·815	1·710	7·624	81·338	5·914	3,043,900	1·019	1·678
Lincoln	853	...	...	10·36	10·17	2·15	·94	1·42	1·40	5·91	57	4·51	190,838	1·25	1·12
Liverpool ...	...	...	100,000	12·25	12·02	3·380	1·227	1·460	2·171	8·238	65·6	6·067	26,007,694	1·14	1·9
Lowestoft ...	...	...	...	9·1	8·8	2·60	·5	1·2	1·8	6·1	67·64	4·3	318,601	1·75	1·03
Maidstone ...	...	...	...	8·51	8·06	2·02	·81	1·34	1·48	5·65	70·07	4·17	371,290	1·25	1·2
Manchester ...	...	...	103,090	11·410	11·236	3·411	1·103	1·105	1·597	7·216	63·25	5·619	30,035,057	1·034	1·543
Nelson	1,980	...	...	12·85	12·78	3·00	·81	1·81	2·51	8·13	63	5·62	255,621	2	1·26
Newport (Mon.)...	...	...	...	10·207	9·950	2·605	1·056	3·239	1·653	8·553	83·74	6·913	1,187,262	1·29	1·23
Nottingham ...	...	6,164	22,500	11·35	11·16	3·06	·93	1·10	1·94	7·03	62·78	5·09	5,806,688	1·25	1·53
Oldham	...	4,901	...	13·422	13·228	3·109	·992	2·570	2·376	9·047	67·40	6·671	3,291,607	1·5	1·585
Perth	...	...	...	8·79	8·31	3·02	·66	·39	1·19	5·26	59	4·07	277,474	1·08	1·09
Plymouth ...	...	...	4,037	12·066	11·450	2·42	1·11	1·29	2·298	7·12	60·83	4·82	1,159,069	1·66	1·38
Pontypridd ...	355	...	...	12·16	11·99	2·78	·78	3·04	1·78	8·38	68·89	6·6	613,719	1·25	1·42
Rawtenstall ...	...	621	...	10·81	10·66	2·33	1·18	1·24	1·71	6·46	59·61	4·75	813,483	1·28	1·34
Rochdale... ...	8,490	...	...	11·163	11·123	2·520	·692	1·307	1·556	6·075	53·4	4·519	2,610,994	1·006	1·546
Rotherham ...	E. ...	4,287	750	12·54	12·52	2·92	·87	2·22	2·79	8·80	70·15	6·01	1,731,184	1·375	2·03
	R.T....	1,009	...	10·74	10·74	2·44	·76	2·68	1·23	7·11	66·20	5·88	120,303	1·375	1·07
Salford	...	...	22,000	10·501	10·499	3·059	·916	·970	1·936	6·881	65	4·945	9,812,392	1·23	1·606
Southampton ...	6,577	...	2,360	10·974	10·520	3·105	·779	1·432	1·915	7·231	66	5·316	2,004,408	1·5	1·29
Southend-on-Sea	2,514	1,000	6,000	13·14	12·97	3·03	·85	1·33	2·33	7·54	57·35	5·21	848,538	1·75	1·33
Southport ...	...	...	...	9·763	9·528	2·462	1·101	1·607	1·554	6·725	68·8	5·171	468,554	1·5	1·011
South Shields ...	(d) 500	4,907	1,700	10·244	10·087	2·362	·993	·971	1·710	6·036	58·92	4·326	1,105,203	1·388	1·231
Stalybridge, &c.	...	...	...	8·426	8·365	2·711	1·013	1·278	1·394	6·396	75·92	5·002	1,793,157	·9	1·549
Stockport ...	...	250	12,250	10·958	10·745	2·388	·738	1·618	·961	5·705	47·94	4·744	...	...	...
Sunderland ...	...	...	5,000	12·00	11·943	3·128	·844	1·034	1·799	6·805	56·97	5·0	1,804,219	1·5	1·19
Wallasey ...	1,443	3,000	7,750	11·844	11·739	3·287	·891	1·211	2·138	7·527	63·5	5·38	1,971,378	1·4	1·52
Walsall	2,479	...	1,000	11·353	11·094	2·834	1·108	1·437	1·888	7·267	64·012	5·379	838,649	1·68	1·164
Walthamstow ...	...	...	...	8·09	7·94	3·05	·66	1·53	1·76	7·00	86·6	5·24	1,495,460	1·375	1·28
Warrington ...	739	...	2,500	12·521	12·246	3·161	·966	2·096	1·798	8·021	68·273	6·223	545,817	1·5	1·199
West Ham ...	...	...	...	9·27	9·075	3·417	1·154	2·137	1·353	8·061	88	6·708	6,974,894	·75	1·85
Wigan	4,690	...	...	12·77	12·46	2·655	·836	1·862	1·761	7·11	56·07	5·35	2,216,740	1 1/16	1·476
Wolverhampton	...	...	5,553	11·485	11·333	2·569	1·039	1·530	1·513	6·651	57·9	5·138	1,845,821	1	1·542
Yarmouth (Gt.)...	...	...	...	8·738	8·563	2·583	·616	1·016	1·649	5·864	68·48	4·215	758,296	1·56	1·052
York	...	2,524	...	9·08	8·86	2·95	·69	·66	1·78	6·08	67	4·30	1,009,827	1·25	1·43

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

									*					Works Cost.	
Belfast	...	...	11,866	9·51	9·38	2·72	·44	1·46	·99	5·61	58·91	4·62	11,000,708	·617	1·37
Bexley	...	..	...	11·13	12·3	2·53	·85	2·82	·68	6·88	71·1	6·20	487,110	·827	1·66
Birkenhead ...	...	...	...	12·643	12·496	3·140	·991	2·170	1·336	7·637	60·33	6·30	2,672,599	·65	2·054
Bournemouth ...	...	2,000	...	12·83	12·76	2·95	1·02	1·26	(b) 1·99	7·22	56·21	5·23	3,245,277	·67	1·65
Cardiff	845	2,047	9,600	11·65	11·45	3·563	·900	1·468	·850	6·781	60	5·931	5,073,942	·488	1·71
Coventry ...	419	...	...	9·271	9·115	2·742	·953	1·694	·819	6·208	66·9	5·389	1,652,029	·544	1·47
Glasgow	...	...	53,892	10·659	10·609	3·271	1·318	1·536	·526	6·651	62·69	6·125	33,685,570	·378	1·38
Huddersfield ...	6,662	14,634	...	11·34	10·98	2·78	·61	2·72	·81	6·92	61·01	6·00	4,881,338	·42	1·94
Hull	...	7,270	7,000	9·47	9·41	2·85	·85	2·38	·67	6·75	71	6·02	5,710,219	·50	1·35
Leeds	...	...	70,005	11·145	11·042	2·967	1·073	1·070	·792	5·902	52·96	5·110	17,175,710	·493	1·801
Leicester	...	...	480	9·875	8·682	3·425	·661	1·325	1·469	6·880	69	5·411	7,540,856	·420	1·82
London	...	...	...	E. 9·21	8·94	3·32	·76	1·41	1·01	6·50	70·55	5·49	154,048,461	·601	2·63
				H. 8·15	7·97	4·07	1·39	1·53	4·40	11·39	139·72	11·39	...	...	...
N'castle-on-Tyne	...	25,135	13,470	11·709	11·253	3·222	1·144	1·217	1·031	6·614	54·96	5·583	10,231,454	·421	1·922
Northampton ...	...	1,200	500	10·69	10·39	2·87	1·15	1·03	1·80	6·85	64	5·05	966,282	1·23	1·47
Portsmouth ...	10,702	(i) 3,000	5,000	11·204	11·030	3·033	1·057	·852	·576	5·518	49·25	4·942	3,056,720	·521	1·103
Preston	...	5,041	1,300	10·75	10·54	2·890	1·168	2·164	·700	6·922	64·40	6·222	1,765,250	·407	1·49
Reading	...	2,529	1,890	9·261	8·996	2·201	·933	1·042	·917	5·093	55	4·18	1,170,173	·737	1·12
Sheffield	7,032	2,000	30,581	10·527	10·431	3·286	·755	1·298	·949	6·288	59·732	5·339	18,601,705	446	1·933
Wellington, N.Z.	15,431	...	...	16·309	16·189	5·974	·801	2·259	1·850	10·884	65·86	9·034	4,769,149	·906	2·05

* The figures given under "Power" in Table II. include actual works costs only. H—Horse lines. E—Electric trolley system. (b) Including current supplied by Bournemouth and Poole Supply Company. (c) Horse account ·054d. (d) Accident, insurance, and compensation fund. (f) Insurance fund. (i) Including Insurance. (k) Insurance. (n) Remainder expended in paying capital expenditure not borrowed. (t) Amounts for 15 months.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Population Served.	Car Mileage.	Passengers Carried.	Traffic Records. Passengers Carried per Car Mile.	Average Fare per Passenger.	Average Journeys per Head of Populat'n per Annum.	Average Car Miles per Day per Car.	Traffic Revenue per Mile of Single Track.	Average Traffic Revenue per Annum per Head of Populat'n Served.	Operating Expenses per Passenger.	Average Distance of 1d. Fare.	Average Fare Charged per Mile.	Average Speed per Hour.	Average Total Car Hours per Day.	Average Number of Cars in Use Daily.	Number of Cars in Stock.
					d.			£		d.	Miles.	d.	Miles.			
Aberdeen ...	165,000	1,832,587	22,218,142	12·11	·91	134·6	93	3,064	10/3	·508	1·80	·58	7·5	703	54	77
Accrington...	45,525	573,536	4,998,979	8·72	1·377	109·8	105	3,033	13/1	·84	1·07	·929	7·5	250	18	27
Ashton-u-L.	50,000	464,160	5,053,701	10·888	·648	173·09	106	2,851	9/4	·368	1·223	·81	8	190	12	25
Ayr	33,000	444,802	4,238,494	9·52	1·04	128	102	1,953	11/1	·606	1·25	·75	8	168	12	22
Birmingham	868,430	14,268,24	146,930,986	10·29	1·03	169	79·77	5,482	14 5	·904	2·	·427	7·87	10·16	500	550
Blackburn ...	200,000	1,121,769	12,223,569	10·89	1·28	61·12	105	2,528	6/6	·902	1·25	·76	7·50	434	31	61
Blackpool ...	67,500	1,075,943	14,289,802	13	1·41	211·7	86·7	4,524	24/9	·73	...	...	8	...	34	78
Bolton ...	221,000	2,888,930	32,019,574	11·08	1·062	144·88	122·85	3,032	13/-	·578	1·553	·633	7·25	1,030	73	112
Bradford ...	370,000	6,255,878	67,675,166	10·816	1·058	182	113	2,792	16/2	·819	1·67	·531	7·3	2,340·5	151	248
Brighton ...	133,096	1,156,584	11,839,515	10	1·11	88·95	83·36	3,176	8/2	·86	1·27	·788	6·41	544	34	50
Burnley ...	175,000	1,754,811	17,668,834	10·07	1·18	101	120	3,971	10/1	·85	1·25	·83	7	874	46	67
Burton ...	48,000	439,248	3,339,184	7·60	1·058	70	...	1,782	6/3	·91	1·505	·58	7·5	...	...	20
Bury	128,202	1,613,357	15,513,264	9	1·07	121·47	99·73	1,904	10 9	·554	1·30	·77	8·54	...	...	54
Chester ...	39,028	347,260	3,217,899	9·26	·95	82·45	95	1,987	6/7	·606	1·27	·8	7	150·6	10·04	18
Chesterfield	50,000	304,376	2,950,774	9·7	1·1	76	122	2,668	5/5	·78	1·38	·75	7·33	126	7	17
Colchester ...	44,700	324,622	1,757,794	6·58	1·42	47·84	89·6	1,309	4/8	1·20	·85	·96	6·78	142·27	9·88	18
Croydon ...	178,094	2,801,302	19,227,878	6·87	1·06	107·56	129	4,818	9/10	·871	2·05	·50	8·14	942·23	59	75
Darlington...	60,000	385,999	4,140,269	10·7	·752	69	96·1	1,460	4/4	·53	1·219	·45	6·66	151·25	11	18
Darwen ...	...	266,912	2,993,697	11·22	1·25	...	...	2,182	...	·88	...	...	...	...	...	...
Derby ...	124,000	E 1,208,880	12,136,148	10·039	1·011	97·88	...	2,398	8/3	·67	1·44	·75	6·375	...	...	50
		H. 17,710	110,231	6·224	·935			...	...	1·35	1	1	..	...	...	3
Doncaster ...	60,000	529,122	5,747,273	10·86	·955	95·79	93·9	1,798	7/7	·711	1·25	·76	7·5	239	18	32
Dundee ...	165,000	1,387,980	19,042,344	13·71	·853	115	...	2,387	8/2	·547	2	·50	7·3	...	...	68
East Ham ...	145,000	1,510,251	16,671,505	11·04	·78	115	150	3,704	7/1	·69	1·638	·634	7	216	32	45
Exeter ...	48,660	446,338	4,320,459	9·68	·97	88·8	82·125	2,498	7/2	·642	1·1	·902	5·76	228	16	20
Gloucester ...	53,972	638,646	4,415,555	6·9	·91	82	92·05	1,122	6/3	·75	1·5	·65	7·08	264·1	19	30
Halifax ...	176,000	2,242,086	20,276,077	9·04	1·26	115	80·21	1,958	12/4	·867	1·30	·87	7·23	853·93	77	101
Ilford ...	84,000	899,515	8,036,552	9·70	·758	95·7	...	2,236	5/7	·62	1·543	·69	8	...	..	26
Ilkeston ...	32,000	241,548	1,746,382	7·2	·95	...	90	1,942	52 8	·8	1·50	·5	7	101	7	13
Ipswich ...	75,681	668,650	5,715,035	8·54	·975	75·51	65·5	1,559	6/1	·84	1·53	·693	5·51	332·80	20·80	36
Keighley ...	43,000	242,500	3,099,272	12·8	·68	72·06	55·35	1,447	4/1	·462	2·22	·45	6·87	126	7	12
Kilmarnock	36,000	297,743	2,482,034	8·33	·875	68·94	93·12	1,632	5/-	·675	1·13	·86	7·22	109·14	8·76	14
Kirkcaldy ...	39,600	470,162	5,781,895	12·3	·726	146	52	1,989	8/10	·475	1·522	·64	7	183	17	22
Lancaster ...	41,786	174,752	1,603,321	9·17	·865	38·37	76	1,204	2/9	·785	1·71	·5	8	87·22	6·23	12
Leith ...	110,400	949,322	10,244,235	10·79	·86	92·8	125	2,031	6/8	·512	1·32	·72	8·3	314	21	37
Leyton ...	124,735	1,813,462	17,472,882	9·64	·950	140	120	3,820	11/1	·791	1·77	·95	8·23	14·5	40·0375	60
Lincoln ...	20,000	164,499	1,826,885	11·11	·907	91·34	65·7	2,350	6·11	·532	1·75	·428	7	90	5	8
Liverpool ...	840,000	13,657,888	145,656,374	10·67	1·127	173·40	89·09	5,516	16/3	·772	2·514	·39	7·75	5,040	420	596
Lowestoft ...	35,000	307,838	2,706,348	8	1·07	77·32	70·25	2,787	6/6	·703	1·5	·7	5·75	192	12	19
Maidstone ...	25,000	309,256	2,407,769	7·783	1·036	96·312	85	1,476	8,4	·725	1	1	6·8	133	12	19
Manchester	945,280	19,463,646	205,608,741	11	1·06	218	94·7	5,054	19/3	·683	...	...	..	...	..	662
Nelson ...	45,000	202,781	2,949,784	14·55	·88	65·55	92·59	2,796	4/9	·56	1	1	5·50	108	6	11
Newport ...	89,400	968,524	9,155,356	9·45	1·08	102·41	100	2,798	9/-	·904	1·164	·898	...	...	34	44
Nottingham	264,000	3,789,887	41,210,964	10·87	1·02	156	95·28	3,984	13/4	·646	1·75	·442	6·92	...	109	155
Oldham ...	180,000	2,077,104	22,773,108	10·963	1·19	126·52	121	3,136	12/8	·825	1·11	·884	7	846	47	92
Perth... ...	35,900	252,940	1,813,228	7·16	1·15	50·5	96·25	1,298	4/7	·73	...	...	6·25	120	8	12
Plymouth ...	112,000	838,142	9,333,087	11·13	1·027	83·33	...	2,666	7/2	·639	...	...	...	...	..	42
Pontypridd .	40,000	432,006	5,047,168	11·68	1·02	126	81·2	2,509	10/9	·71	1·25	·81	6·5	221	17	26
Rawtenstall	50,000	604,807	5,201,893	8·60	1·22	104	138	1,691	10/9	·751	1·12	·88	9	247·5	15	24
Rochdale ...	130,000	1,778,030	14,584,777	8·16	1·36	112·2	114·90	2,079	12/9	·731	1·07	·90	7·66	660	44	69
Rotherham...	64,000	E 852,639	9,874,231	11·58	1·08	154·3	...	3,701	13/9	·76	...	...	...	...	...	...
	...	RT 128,685	471,690	3·67	2·72	...	...	...	...	1·92	..	...	...	...	...	...
Salford ...	350,000	6,235,278	53,124,546	8·52	1·227	151	108	3,646	15/7	·88	2·20	·46	7·916	2,054	158	200
Southampt'n	122,200	1,543,941	13,162,224	8·52	1·23	108	77·38	3,624	11·1	·82	1·25	·55	...	...	...	70
Southend ...	78,000	637,366	7,581,104	11·89	1·09	97·2	87	4,708	8/10	·634	1·41	·76	6·5	357	21	31
Southport ...	31,312	463,262	4,663,579	10·067	·94	148·62	98	1,710	11/5	·677	1·6	·62	6·65	825	15	26
So'th Shields	111,357	898,015	10,005,164	11·414	·905	90	110	3,677	6/9	·54	3·1	·38	8·06	338	20	35
Stalybridge	94,063	1,157,163	9,900,591	8·556	·977	105·3	79	1,698	8/7	·748	1·22	·72	6·8	466	40	59
Stockport ...	120,000	1,490,116	...	...	...	...	...	2,356	11 2	...	..	..	..	...	...	...
Sunderland	170,000	1,504,356	18,475,671	12·2	·972	108·6	78·4	3,679	8/9	·554	1·34	·68	7	688	43	70
Wallasey ...	84,500	1,291,046	13,105,204	10·15	1·15	155	99·6	3,163	14/11	1	1·89	·54	7	525	48	61
Walsall ...	100,000	720,634	6,752,727	9·371	1·184	68	94	1,905	6/7	·775	1·24	·79	7	315	21	39
Walth'mst'w	130,000	1,166,027	12,579,852	10·788	·756	96·76	95	2,883	5/11	·65	1·18	·86	7·5	430	37	38
Warrington	86,000	455,304	6,134,545	13·473	·909	71·332	102·423	2,406	5/5	·59	1·246	·803	6·401	194·86	12·175	21
West Ham ..	296,600	3,756,354	41,152,502	10·95	·828	138	92	4,726	9/7	·73	1·80	·51	7·75	1,235	95	118
Wigan	200,000	1,500,846	14,295,274	9·52	1·308	71·47	93·45	2,525	7/9	·74	1·15	·88	7·4	605	44	67
Wolverh'ton	135,000	1,195,326	12,616,881	10·555	1·07	93·44	89	2,625	8/4	·631	1·25	·879	6·85	660·6	36·7	52
Yarmouth ...	56,000	720,702	4,930,728	6·84	1·231	88·05	79	1,746	9/2	·857	1·25	·76	7	375	25	35
York	82,600	707,370	5,946,843	8·41	1·05	72	108	2,193	6/2	·73	1·33	·789	8	270	18	31

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast ...	390,000	6,865,591	63,131,820	9·19	1·02	162	128	2,709	13/9	·61	1·96	·43	8·75	2,350	257	289
Bexley	16,500	316,970	2,270,070	7·16	1·55	133	126	2,922	19/10	1·24	1·59	·63	9·5	179	11	16
Birkenhead	135,740	1,300,717	15,167,958	11·66	1·071	111·74	69·98	2,811	9/11	·71	1·39	·66	6·24	520·61	50·94	65
Bournem'uth	120,000	1,962,352	17,182,844	8·76	1·46	143	95	3,505	17·5	·824	1·19	·87	6·8	1,140	60	81
Cardiff ...	182,729	2,966,230	31,122,962	10·49	1·09	170	98·5	4,447	15·6	·65	1·44	·736	7·5	1,264	79	130
Coventry ...	135,000	1,125,705	8,407,719	7·5	1·22	62	66	2,714	6·4	·831	1·18	·866	6·4	476	40	46
Glasgow	1,150,000	24,403,482	336,654,624	13·795	·769	292·74	106·18	5,499	18·9	·482	2·31	·44	8·13	8,815·65	629·69	851
Huddersfield	160,000	(a) 2,461,107	22,616,710	9·21	1·19	174	82	3,634	14/1	·766	1·35	·71	7·62	885·28	55·33	96
Hull ...	291,118	4,229,625	45,679,094	10·08	·871	156·91	127·60	5,004	11/3	·603	2·75	·364	9	1,453·12	90·82	160
Leeds ...	525,000	9,204,331	93,679,774	10·17	1·081	178	115·41	3,694	16/2	(b) ·916	1·93	·539	7·56	3,339	222	318
Leicester ..	232,644	4,137,262	37,914,773	9·146	·947	163	108·35	4,045	12/10	·751	2·18	·45	8	1,451	...	160
London ..	...	E58,572,356	516,338,859	8·82	1·01	...	120·18	7,866	...	·73	...	...	9·05	17,728·8	1,335	1,722
		H 636,933	,613,781	10·38	·77	...	77·12	1,519	...	1·09	...	...	5·85	203·14	23	56
Newcastle ...	300,000	5,353,875	57,840,666	10·81	1·071	193	100	3,992	16/9	·612	1·58	·633	7·5	...	133	200
Northampt'n	91,500	658,809	7,304,863	11·09	·94	82·73	...	3,102	6·4	·617	1·34	·7	...	...	...	26
Portsmouth	245,827	2,506,058	26,266,342	10·481	1·052	106·85	90·34	3,325	9/5	·527	1·66	·62	7	1,140	76	100
Preston ...	120,000	1,025,738	10,340,688	10·08	1·04	86·17	132	2,652	7·7	·764	1·01	·95	7·36	404·7	21·3	33
Reading ...	76,500	941,303	8,865,128	9·42	·97	116	110·5	2,680	9/2	·54	1·59	·68	7·5	352	26	36
Sheffield ...	479,622	8,883,576	104,851,408	11·803	·884	218·594	104·644	4,885	16·1	·533	2·789	·379	...	3,372·5	232·587	335
Wellington	70,000	2,328,849	24,565,376	11·28	1·43	359	85	4,708	44/10	1·031	1·125	·89	7·59	840	75	92

E—Electric trolley system. H—Horse lines. (a) Including 9,395 miles coal haulage. (b) Total expenses per passenger.

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drawal of the excursion fares on the railways the tramway traffic would probably have been very large. If no strike had occurred it is probable that the receipts of the Council's tramways to the beginning of June would have been £90,000 more than the present total. It is satisfactory to observe that for the week ended June 16 the receipts showed an increase of £175 on those for the corresponding week last year—£44,012, as against £43,837.

Huddersfield Corporation Tramways.—The report of the Tramways Committee for the year ended March 31, 1915, shows that the total revenue was £127,060, as against £116,320 last year, the revenue from passengers amounting to £123,756, as compared with £112,317; parcels, £1,422, as against £1,453; and there was also increased revenue from the conveyance of postmen, but decreases in reference to advertising, coal haulage, and sundries. The total working expenditure was £73,979, as compared with £70,971, and the cost per car-mile had decreased from 6·92d. to 6·44d. Traffic expenses had increased from £28,548 to £35,080; power expenses from £8,349 to £12,047; and general expenses from £6,253 to £6,313; but general repairs and maintenance had decreased from £27,821 to £20,539. The gross surplus was £53,081, as compared with £45,349; and the surplus, after paying interest on capital and redemption of debt, was £23,975, as against £21,296. Allowing for depreciation, the surplus was £10,208, as compared with £8,800. It was resolved that the credit balance of £10,207 10s. 11d. be allocated as follows:—That £8,400 be transferred to the borough fund in relief of the borough rate, and the balance of £1,807 10s. 11d. to reserve and renewals account, making the total amount in that account £7,521 16s. 7d., and that the following expenditure during the past financial year be charged to reserve and renewals account, viz., Outlane and Sheepbridge doubling, £16,542 17s. 10d.; purchase of Y.M.C.A. building, £7,729 7s. 1d.; cars and equipment, £15,838 12s. 6d.

Bury Corporation Tramways.—The working of the tramways during the year ended March 31, 1915, resulted in a net surplus of £8,791. Of this amount £5,000 has been contributed to the borough rates, £2,472 has been carried to the reserve and depreciation fund, £1,000 to the insurance fund against third party claims, and £601 has been refunded to the borough rates on account of the previous loss on the Radcliffe tramways. The total amount of the reserve and depreciation fund is now £30,862, and insurance fund £3,097, in addition to which the sum of £55,416 has been set aside in the sinking fund and loans fund, making a total of £89,376. The total capital expenditure now amounts to £293,237. Included in the expenses of the past year is an amount of £897 paid as war allowance to the men who have joined the colours. The tramways worked by the Corporation include the routes in Bury and the Radcliffe, Heywood and Salford sections. During the past year two routes have been extended, the Limefield section by a length of 1,100 yards of double track and the Jericho section by a length of 770 yards of single track. The rolling stock consists of 54 cars, including 14 73-passenger double-deck bogie cars without top covers and 40 56-passenger double-deck single-truck cars with top deck covers. The total revenue amounted to £69,015. The mileage was 1,613,357, a decrease of 17,769. The passengers carried were 1,513,264, a decrease of 218,223. The working expenses were £35,766, a ratio of 51·82 per cent. to the receipts The annual consumption on the Bury section was 1·286 units per car mile. The average total revenue per car mile was 10·02d. and the working expenses per car mile, including power cost, was 5·696d.

UNIFICATION OF THE LONDON UNDERGROUND SYSTEM.

The Parliamentary Committee of the London County Council has recommended that the Council should oppose the London Electric Railway Company's Facilities Bill, 1915, that the Board of Trade should be placed in possession of the Council's views, and that the attitude of the Board of Trade to the Bill should be ascertained if possible. The object of the Bill is to enable the City and South London, the Central London, the London Electric, and the Metropolitan District Railways to enter into agreements with each other or with the London General Omnibus Company, with respect to interchange, routeing, and working of passenger traffic, and the application of the receipts of the companies arising from such traffic, and the payment of revenue, into a common fund after providing for certain payments—viz., rent, rent charges, interest on debentures, and dividend on guaranteed stocks. Power is also being sought to use the common fund to make good deficiencies in revenue of any company not able to make the payments mentioned and for the division of the balance of the fund. The Finance Committee point out that the incidental result of the Bill will be to give a certain statutory recognition to the London General Omnibus Company which, as an ordinary limited liability company, has no parliamentary standing. Unity of management has been effected, unity of interest is now proposed, but the committee remark that it remains to be seen that the interests of the public are fully secured. Meetings of the companies concerned were held recently, when resolutions approving of the Bill were passed.

CONTRACTS AND ORDERS.

Edinburgh Corporation have obtained an Edison electric lorry at a cost of £695.

Messrs. Edward Le Bas have an order from Southend-on-Sea Corporation for overhead trolley wire.

The British Thomson-Houston Company have an order for switchgear from Darlington Town Council.

The Bell Punch and Printing Company have received the contract for the supply of tickets to Dover Tramways.

Brown Bayley's Steel Works, Limited, have received a contract for the supply of 500 steel tramcar tires to Sheffield Corporation.

Salford Eelctricity Committee have accepted the tender of the British Westinghouse Company for a 5,000 KW. turbo-alternator at £16,200.

The Edison and Swan United Electric Light Company, Limited, have an order from the Caledonian Railway Company for "Royal Ediswan" lamps.

London County Council have accepted the tender of Mr. T. D. Levy, Deptford, at £1,423, for the erection of an extension to the Woolwich tramways sub-station.

Edward Dennis & Company, Limited, have received an order from Manchester Corporation for four complete chain grate stokers for the new Babcock and Wilcox boilers recently installed.

The General Post Office have accepted the tender of the Edison and Swan United Electric Light Company, Limited, for six months' supply of "Royal Ediswan" (tungsten) drawn wire lamps.

Carlisle Town Council have renewed the agreement with the Tudor Accumulator Company, Limited, for the maintenance of the battery at the electricity works for a period of ten years

The British Westinghouse Electric and Manufacturing Company Limited have an order from the Swansea Electricity and Tramways Committee for a 2,500 KW. rotary converter, transformer, and switchgear at £970.

Bradford Tramways Committee have placed contracts as follows:—M. and G. Truck and Engineering Company, Limited, 100 tramcar trucks at £87 each; Brown, Boveri and Company, Limited, 200 tramcar motors at £110 each.

Lowestoft Electricity Committee have recommended the acceptance of the tender of Messrs. Bradbury, Son and Company for the supply of 500 tons of coal at 19s. 2d. per ton, and of Messrs. Kaye, Son and Harper for 2,000 tons at 19s. per ton.

Chesterfield Town Council have placed the following contracts:—400 KW. alternator, British Westinghouse Company, Limited; boiler, superheater, and mechanical stoker, Babcock and Wilcox, Limited; and economiser, Clay Cross Iron Company, Limited.

Croydon Lighting and Electricity Committee have placed an order with J. H. Gilman and Company for 3,000 tons Kingsbury Ryder beans at 24s. 10d. per ton; 2,500 tons Mapperley small nuts, 25s. 6d. per ton; and 3,500 tons Portland and Linby slack, 23s. 6d. per ton.

H. Lotery & Son, London, supplied the uniforms and caps worn by the female conductors employed on the Edinburgh tramways. The same firm have contracted for the uniforms of the battalion raised by Sir George M'Crae, in which many of the tramwaymen have enlisted.

J. W. Courtenay, Limited, of Amberley House, Norfolk Street, London, W.C., have recently been appointed sole advertising contractors to the Bradford, the Southampton, and the Halifax Corporation Tramways In each case the contractors' remuneration will be computed on a commission basis.

Sunderland Council have accepted the following tenders:—British Thomson-Houston Company, Limited, bearings for split-poles rotary; Doulton and Company, stoneware insulators; Key Engineering Company, cable ducts; British Insulated and Helsby Cables, Limited, E.H.T. cable and copper strip.

Sheffield Council have accepted the following tenders:—For the complete renewal of mechanical stokers of four boilers at Neepsend Power Station, Underfeed Stoker Company, Limited, London, £3,105; for the supply, delivery, and erection of two water-cooling towers, including foundations and accessories, Bradshaw and Company, Manchester (subject to Finance Consultative Committee's approval), £8,514.

The Victorian Railways Department have accepted the following tenders in connection with the electrical equipment of Melbourne Suburban Railways:—Track, feed-boxes, signal transformers, switchgear, etc., £15,512, A. Reyrolle and Company, Limited; electrically-operated car shed cranes, £4,480, Chambers, Scott and Company, Limited; track bonds, £7,085, B.I. and Helsby Cables, Limited; fuse, distribution boxes, and fuses (schedule rates), Siemens Brothers, Dynamo Works, Limited.

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PERSONAL.

Mr. J. A. Parker has been appointed chief clerk in the Belfast Corporation power-station.

Mr. J. G. B. Stone has been appointed director of Madras Electric Tramways, Limited, in place of the late Mr. T. E. Ivens.

Mr. John Ward, manager of the Dudley and Stourbridge District Tramways, has enlisted in the Royal Army Medical Corps.

Mr. E. C. Geddes, deputy general manager of the North Eastern Railway, has been appointed director of railways in the Ministry of Munitions.

Mr. S. J. Watson, borough electrical engineer to Bury Corporation, has been granted by the Council an increase of salary from £500 to £650.

Mr. G. H. Margrave, chief clerk in the office of Northampton Corporation Tramways, has been appointed manager of Wolverton Steam Tramways.

Mr. F. Harris will give evidence on behalf of the Institution of Municipal and County Engineers to the Departmental Committee on Heavy Traffic.

Mr. P. Taylor, assistant clerical engineer to Darwen Corporation, has been appointed staff sergeant in the Mechanical Transport, in which he recently enlisted.

Mr. W. Clough, manager of the Bury Corporation Tramways, has been authorised by the Bury Tramways Committee to act on the local munitions committee.

Mr. P. N. Gray, manager and secretary of Gravesend and Northfleet Electric Tramways Company, has been elected a director in the place of the late Mr. J. F. Albright.

Mr. G. H. Margrave, chief clerk of Northampton Corporation Tramways, has been presented by the staff with a marble clock on his leaving to take up another appointment.

Mr. J. G. Griffin, general manager of the Delhi Electric Tramways and Lighting Company, Limited, is at home on leave for a few weeks. His address is Basildon House, Moorgate Street, London, E.C.

Mr. R. J. Mitchell has resigned his position as commercial engineer to Edison Accumulators, Limited, and will take up a position as engineer to Mr. E. S. Shepherd, of Gray's Inn Passage, Holborn, W.C.

Lieut. G. C. Milnes, of the 5th King's Own Loyal Lancashire Regiment, and late general manager and electrical engineer to Lancaster Corporation Tramways, is among those mentioned by Field-Marshal Sir John French for gallantry in the field.

Mr. J. W. Towle has resigned his position as Superintendent of Power with the Underground Electric Railways Company to accept the position of chief engineer of the Barcelona Traction, Light and Power Company. Mr. Towle expects to leave England early next month.

Mr. T. H. U. Aldridge, electrical engineer of the Shanghai municipality, sailed for England *via* the United States on May 29, and expects to be in England toward the end of July. During his visit tenders will, it is understood, be invited for additional generating plant, transformers, etc.

Mr. A. R. Fearnley, general manager Sheffield Corporation Tramways, has been authorised by the City Council, at the request of the Municipal Tramways Association, to act as the municipal tramways representative on the Electric Vehicle Committee of the Municipal Electrical Association, and to attend the meetings when matters relating to motor vehicles are to be dealt with.

Mr. C. W. Mallins in June completed forty years' service with tramway undertakings in Liverpool. Since he succeeded the late Mr. Bellamy in 1905 as general manager of the Corporation tramways, his work has been marked by great enterprise, notably in car design, the development of a boulevard tramway route, and the running of motor omnibuses. His advice is often sought by other municipalities.

Mr. J. F. Cameron has been appointed general manager of Northampton Corporation Tramways. Six months ago Mr. Cameron, who was electrical engineer to the undertaking, was appointed temporary manager consequent on the resignation of Mr. J. Gottschalk. The late manager, who was of German birth, received £300 compensation. Mr. H. W. Sykes has been appointed chief clerk, and Mr. I. J. Gee second clerk in the tramways office.

Dublin Tramways Company.—Consequent on the lamented demise of Mr. Tresilian and Mr. Gordon, late secretary and manager of the company respectively, Mr. George Marshall Harriss, the chief electrical engineer, has been appointed general manager. Mr. Tennan, a member of the electrical staff, becomes principal electrical engineer. Mr. Brophy, principal assistant to Mr. Gordon, is appointed traffic manager. Mr. M'Hugh, the chief accountant, is appointed as secretary, and his principal clerk, Mr. Rathborne, as chief accountant in his place.

OILSKIN CLOTHING FOR MOTORMEN.

By L. E. Harvey, A.M.I.E.E.
(Manager and Engineer, Ilford Corporation Tramways).

The obtaining of a thoroughly waterproof garment for tramway motormen has always been a source of difficulty to those who have to provide them, and, indeed, up to the present there has been no garment that can withstand for any length of time the particularly rough usage incidental to the work. The weak spot in all the garments has been the inside of the elbow of the sleeve. The continual movement of the motormen's arms due to the revolving motion of the brake and controller handles causes constant working of the material of the sleeve just at the point mentioned, and whatever the quality of the material, whether paramatta or dressed oilskin, cracks or thin places will sooner or later appear at this point, with the result that water running down from the top part of the garment immediately finds out the weak spot and penetrates the man's underclothing, so that after a wet shift one often sees a man come in with the sleeves of his coat and shirt thoroughly soaked.

In many years of tramway experience I have never come across a garment that can withstand the peculiar nature of the work of the tramway motorman, although I have tested practically every

Oilskin Coat for Motorman.

available type and material. One of the results of the want of a thoroughly serviceable waterproof garment has been that tramway concerns have been put to great expense and trouble in providing vestibule ends or weather screens of some type or other, the latter being, as a rule, unsightly in the extreme, inefficient, and troublesome in upkeep. I have always held that all such expedients are worse than the evil, because with them you are always faced with the question of bad draughts and the blurring of the glass in wet and snowy weather.

In view of this therefore I have much pleasure in bringing to the notice of tramway managers an invention of my chief inspector, Mr. J. C. Richards, which entirely gets over the difficulty of providing an efficient garment. As can be seen from the illustration, the sleeves of the garment are made of a number of small overlapping capes, rendering it very flexible, and which shed the water right down the sleeve without any possibility of penetration. The garment also has a very serviceable cape, which is not too big, and this additionally protects the shoulders. It can be made in any weight or any quality of material, but in my opinion the heavier it is the better. The additional cost of the garment is very small, and although, perhaps, it is not so sightly as an ordinary oilskin, still I believe that its advantages are sufficient to outweigh the rather unusual appearance.

Death of Mr. R. W. Smith Saville.—Mr. Smith Saville, borough engineer of Darwen, died on June 2, after an illness extending over two months. He carried out the electrification of the tramways, the construction of the new line to Hoddleston, and the erection of the electricity works, and for several years he was joint manager of the tramways undertaking.

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TRAMWAY AND LIGHT RAILWAY NOTES.

BIRMINGHAM.

War Bonus.—Traffic Employees and Women Conductors.

Birmingham Corporation recently raised the wages of all employees receiving less than 32s. a week, and on June 1 they agreed to an increase of 2s. a week to men who did not benefit by the first concession. The tramway employees are among those who are principally affected. Application was made to Birmingham Watch Committee on June 16 to license youths between 17 and 21 years of age as conductors on the systems of the South Staffordshire Tramways Company, Birmingham and District Power and Traction Company, and Birmingham and Midland Motor Omnibus Company. A representative of the companies stated that their employees had refused to work if women were engaged. As the companies were carrying men who were engaged in munition works, they could not run the risk of a strike, and had been compelled to yield to the threat of the men. Alderman Brooks condemned the action of the men as unpatriotic, and the committee decided that the police should issue licenses only to youths between school age up to 18 years.

BOURNEMOUTH.

Bonus on Profits to Tramwaymen.

In pursuance of an arrangement made since Mr. I. Bulfin became general manager, a bonus of 1½ per cent. on the profits of Bournemouth tramways has been distributed among the employees. The distribution this year is on a basis of over £9,000.

DUNDEE.

Invalided Soldiers the Best Conductors.

In presenting a number of men recently to Dundee for license as conductors, Mr. Fisher, the tramways manager, said six of them were discharged soldiers who had been at the front and several of them wounded. The Lord Provost thought a preference should be given to discharged soldiers. Mr. Fisher, on June 23, asked for licenses for nine more ex-soldiers, and said that the men who had come back from the war were the best class of conductors they had secured since the present shortage of labour. A goodly number of civilians did not remain long with the tramways, as, being men of settled habits, they did not seem to care for the night work.

GREENOCK.

Trailers to be Run.

Greenock Council has agreed to allow the Tramways Company to run trailers early in the morning, at meal hours, and in the evening, when workpeople are returning. During the discussion the proposal was objected to on account of the narrowness of the streets, and an amendment to grant permission during the period of the war only was defeated.

HULL.

Tramway Crossing over a Railway.

Colonel von Donop, of the Board of Trade, has authorised the running of the Hull Corporation tramcars over the Dairycoates level crossing of the North Eastern Railway. At his inspection of the track he tested a mechanical arrangement which has been devised in order to prevent a car attempting to proceed over the crossing when the gates are closed. By this connecting link passengers are now able to proceed to and from Pickering Park without having to walk over the railway.

LONDON.

Permanent Way Apprentices.—The War Bonus.

London County Council has adopted a scheme for the apprenticeship in the permanent way section of lads who desire to become paviors or stone-dressers. The age of entry will be 16 years, and the term of apprenticeship five years. At their meeting on June 22 the County Council agreed to a recommendation by the Highways Committee to refer to the Conciliation Board the question of extending the temporary war grant to officers and employees whose ordinary rate of pay does not exceed 40s. a week. In accordance with the offer made by the chairman of the Highways Committee to the tramway employees before they withdrew their labour, the tramway authorities during the last two weeks in June met representatives from every depot on the subject of the men's grievances. The existing agreement expired on June 26, and the new demands come before the Conciliation Board in July.

LIVERPOOL.

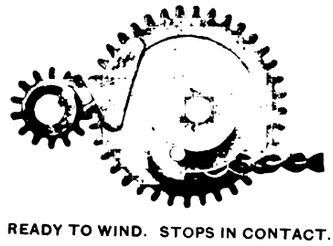
Tramway Employees Producing Shells.—Expected Recall of Mechanicians.

Under an offer made to the Minister of Munitions by the Tramways Committee their employees are now producing a large number of shells weekly. All ranks among the tramways employees are devoting their spare time to the work under the direction of Mr. C. W. Mallins, the general manager. Mr. Lloyd George visited Liverpool on June 4 to discuss with local engineers the manufacture of munitions in Liverpool, when he congratulated the Corporation on being the first local authority to undertake shell making. It was announced by the chairman of the Tramways Committee recently that they would find they would not require to send any more of their men to the army, but would have to recall some turners and fitters for work

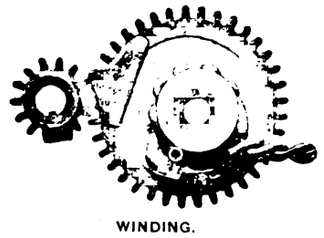
Note the STOPS which form the special feature of The "Peacock"

IMPROVED BRAKE
(Patent),

and by preventing the drum from over-running on release, save three quarters of a revolution of the handle at each application.



READY TO WIND. STOPS IN CONTACT.



WINDING.

"PEACOCK" BRAKES
(PATENT)

Have been supplied to the following tramways amongst others:—

MANCHESTER	698
BIRMINGHAM	458
SALFORD	428
METROPOLITAN	728
CROYDON	150
HASTINGS	130
WAKEFIELD	130
NOTTINGHAM	112
RHONDDA	108

NOTE.—The stops being cast solid with the wheel and pinion in no way detract from the simplicity of the Brake nor increase the cost of maintenance.

The "PEACOCK" BRAKE CO., 27, Clements Lane, LONDON, E.C.

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essential to the war. A statement since made in the House of Commons shows that employers have been asked to name men whom they desire should be recalled to the workshops.

MANCHESTER.

PARCELS SERVICE.—PLEASURE TRAFFIC.

The parcels department of the Manchester Corporation Tramways continues to show a healthy growth. For the year ended March 31, 1915, the receipts amounted to £13,571. The expenses were £9,932, leaving a profit on working of £3,639. Included in the expenses is an amount for £43 16s. 5d., expended as tramway fares by messengers. Holiday suggestions given in a leaflet issued by the Manchester tramways department, combined with the fine weather, have assisted in inducing the citizens to avail themselves in large numbers of the facilities afforded by the tramways for securing change and fresh air.

NEWPORT.

RAILWAY MANAGER ADVOCATES TRAMWAY EXTENSION.

Mr. J. H. Vickery, general manager of Newport and South Wales Docks and Railway, and who until 1913 was with the London and South Western Railway, has urged the Newport Corporation to consider the question of extending its tramway service to the docks. The suggestion was put forward in the course of some remarks which Mr. Vickery made at a reception given on June 21 by the newly-elected chairman of Newport Shipowners' Association. There were constant complaints, he said, that the shipping interests were too far away from the docks.

OLDHAM.

CURRENT CONSUMPTION STATISTICS.

Mr. J. W. Dugdale, general manager, Oldham Corporation Tramways, recently reported as to the reasons for the increase of £400 in the payment for power from January 24 to March 25 last, although there had been a decrease in the number of miles run. Mr. Dugdale attributed the increase to the supply of low voltage from the electricity station; the abnormal frequency of greasy rails and snow; the enlistment of 49 motormen in the Forces; the increased difficulty in finding suitable men to act as motormen and their hasty training; the heavy loading of the cars due to the reduced service; increased amount of sickness among old motormen and inspectors; and to practically all the skilled men in Hollinwood depot having been turned on to Government work. After submitting a comparative statement of the number of units consumed, miles run, units per car-mile, and cost of energy for the years ending March 25, 1912, 1913, 1914, and 1915, Mr. Dugdale concluded:—"From the above figures you will see that for the period of my directorship, namely, March 25, 1911, to March 24, 1915, there were 2,415,878 fewer units consumed, although 319,868 more miles were run, and a total saving in the current bill of £14,506 9s. 6d. on the last four years compared with the previous four. I may further add that the saving in current from March 25, 1911, to March 24, 1915, amounts to £3,476 0s. 5d., although there has been an increased mileage of approximately 150,000. For the last financial year there has been a saving in current from March 25, 1914, to January 24, 1915, of £434 6s. 1½d., and from January 24, 1915, to March 25, 1915, there has been an extra expense for current amounting to about £400."

PLYMOUTH.

LOAN FOR NEW CARS SANCTIONED.

Plymouth Tramways Committee has received sanction from the Board of Trade to the borrowing of £5,000, repayable in fifteen years, for the purchase and equipment of six new cars. The order was granted subject to the condition that the consent of the Treasury must be obtained before any portion of the money is raised by the issue of stock, bonds, or bills.

SHEFFIELD.

RAISING WAR FUNDS ON TRAMCARS.

The appeal of the Lady Mayoress made on the tramcars for funds for the purchase and equipment of motor ambulances for the British Red Cross Society resulted in £1,105 being collected. Several hundred pounds have been collected for the Serbian and Belgian Relief Funds, as well as for the purchase of comforts for wounded soldiers in the Sheffield Base Hospital. The collections for the week ending June 19 are to be allotted to the Sheffield Royal Infirmary and the Royal Hospital, which institutions receive wounded and disabled soldiers.

YORK.

THE TREASURY AND NEW EXPENDITURE.—TRAILER INSURANCE.

On the understanding that York Council will use every effort to reduce all new capital expenditure to a minimum, the Treasury have raised no objection to the borrowing of the following sums:—Motor omnibuses, £5,350; Clifton Green Street works, garage, and booster, £700; Fulford cottages, £7,374; Hull Road and Haxby Road tramways, £30,681. The two last-mentioned items the Treasury had felt much hesitation in approving. The Tramways Committee has accepted an offer to extend the third party policy on the tramways to cover liability in respect of trailers at the additional rate of 1s. 6d. per 100 miles run.

NEWCASTLE BUSINESS MEN AND TRAMWAY WORK.

The Newcastle-on-Tyne Tramways Committee has made a new departure. For some time past the extraordinarily heavy traffic of workmen to and from the shipbuilding yards, engineering factories, and munition works has caused a good deal of trouble, owing to the fact that so many of the tramway employees had either joined the army, navy, or had gone to the factories that are producing ammunition for the forces. Whilst the Tramways Committee were turning out each morning all the available cars that they possibly could with the depleted staff at their disposal, the number was nothing like sufficient to meet the demand at that particular period when the workmen are going to the works.

A few weeks ago the position became so serious that the chairman of the committee, through the local newspapers, asked the business men who were willing to turn out at 4.30 in the morning to volunteer their services to become motor men and conductors for those special workmen's cars, so that the committee might be in a position to increase the number run each day from 120 to 150 or more according to the demand. The idea was at once taken up by the officers and members of the Volunteer Training Corps, who offered their services, 150 names being sent in of members willing to be trained to do the work.

During the past few weeks about 40 have been in training, and this week began duty on the early morning workmen's cars. The committee are paying them 7½d. per hour for the work done, although the greater number of the members of the Training Corps are handing the money paid to them over to the charities of the city. Their assistance is a great relief to the committee, who are now able to run a larger number of cars and thus meet the demand of the workers engaged on war work.

PATENT LIST.

Specially abstracted for "The Tramway and Railway World" from the Official Journal of Patents.

APPLICATIONS.

7,754 Apparatus for sanding rails—J. V. Geraghty.
7,770 Manufacture of solid rubber tires—Dunlop Rubber Co.
7,776 Variable-speed transmission devices—P. M. Justice (*Bethlehem Steel Company*).
7,811 Train-stopping device—E. Allen.
7,816 Sectional pneumatic tires—J. Huybrechts.
7,840 Electric signals—A. C. Brown.
7,907 Means for facilitating the starting of engines of motor vehicles—T. W. Woodhouse and F. B. Popplewell.
7,934 Means of controlling power apparatus driven by internal combustion engines—Thomas Transmission, Limited.
7,970 Pneumatic tires—R. L. Leach.
8,040 Construction of motor vehicles—H. Morin, *dit* Gauthier.
8,151 Superheaters for locomotive boilers—Heenan and Froude, Limited, and J. N. D. Heenan.
8,165 Pneumatic tires—W. A. Leslie.
8,189 Accumulator cases for motor vehicles—P. A. H. Mossay.
8,199 Transmission of signals to rail vehicles—W. F. J. H. Bouman.
8,245 Electric welding and apparatus therefor—British Thomson-Houston Company, Limited (*General Electric Company*).
8,271 Railway vehicles—W. J. Mellersh-Jackson (*Etablissements Arbel, Forges de Douai, Forges de Couzon Soc. Anon.*).
8,318 Mechanism for operating electrically-worked tramway and railway track points—J. Murray.
8,326 Electric welding and apparatus therefor—British Thomson-Houston Company, Limited (*General Electric Company*).
8,328 Railway signalling—J. P. O'Donnell and H. S. Knox.
8,360 Resilient tires for motor vehicles—A. Tomlins and J. Hamblet.
8,374 Fluid-pressure braking apparatus—W. V. Turner.
8,375 Fluid-pressure braking apparatus—P. H. Donovan.
8,376 Safety device for use with electric vehicles—W. V. Turner.
8,378 Fluid-pressure braking apparatus—W. V. Turner and P. H. Donovan.
8,407 Rail joints—H. A. Gill (*Hatfield Manufacturing Company*).
8,467 Resilient tires—W. C. Sneyd and H. E. Young.
8,515 Points for tramways—Edgar Allen and Company, Limited, and G. H. Lockwood.
8,526 Resilient tires—W. C. Sneyd and H. E. Young.
8,536 Locking devices for points, switches, and other movable parts of crossings of permanent ways for railways and tramways—F. St. J. Gebbie.
8,543 Electric welding apparatus—British Thomson-Houston Company, Limited (*General Electric Company*).
8,610 Electrical traction—C. Corbridge.
8,651 Railway signalling systems—H. W. Moore and R. G. Berry.
8,655 Signalling apparatus—M. H. Galsworthy.
8,764 Motor road vehicles—F. L. Lucas.

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8,817 Brake mechanism—C. V. Rote.
8,868 Device for shifting points on railway and tramway lines—R. Ruch.
8,916 Concrete sleepers—R. M. Livesey.
8,936 Railway chair fittings—W. Garvie, C. Forbes, and J. Forbes.
9,050 Railway locomotives—A. G. Spencer.
9,197 Fish-plates—L. Henry.
9,250 Automatic prevention of collisions on railroads—J. H. A. Spaink.
9,257 Springs for railway vehicles—R. T. Glascodine.
9,275 Automatic train stops or brakes—G. R. Nevitt.
9,334 Fenders for automobiles—E. S. Jones and J. L. Taylor.

Specifications Published.

1914.

7,316 Apparatus for operating the couplings of railway vehicles—Troanca.
18,062 Railway signalling apparatus—Wolff (*Fielding*).
10,859 Controlling devices for locomotive cylinders—Stenning, and Schmidt's Superheating Company.
11,027 Railway control and protective systems—Gollos.
11,445 Railway signalling apparatus—Martin.
11,446 Automatic couplings for railway vehicles—Martin.
11,519 Motor vehicles—Bradshaw.
11,739 Insulating devices for electric traction systems—British Thomson-Houston Company (*General Electric Company*).
11,803 Automatic block signalling systems for railways—Wight.
18,143 Electrical conduit systems—Railing and Taylor.
6,543 Brakes for railway vehicles—Masson.
12,047 Self-propelled vehicles—British Thomson-Houston Company (*General Electric Company*).
12,458 Ventilation of railway vehicles—Mead, McLean and Company, and Mead.
15,013 Motor omnibuses—Weaver.
16,572 Railway vehicles—Smith
16,880 Apparatus for controlling trains—Wright.
13,097 Railway signalling—Saul and Greenhalgh.
20,635 Tramway rail joints—Major.
24,392 Signalling system for controlling the traffic in streets—Kelley.
5,774 Track couplings—Schilling.
15,234 Railway carriage station indicator—Dixon.

1915.

4,832 Wheel brakes—Westwood and Somerville.
3,712 Railroad ties or sleepers—Polick.
289 Axle casings for motor road vehicles—Smith and Van Vestraut.
2,853 Car wheels and axles—McCoy.
5,769 Apparatus for controlling and stopping trains independently of drivers—Bound and Rowland.
429 Brakes—Alden.
1,191 Air brake apparatus—Canion.
3,032 Rails for tramways—Grant and Williams.

Colonial and Foreign Tramways Traffic Returns.

NAME OF COMPANY.	1914. WEEKS ENDED. May 30.	June 6.	June 13.	June 20.	1915. WEEKS ENDED. May 29.	June 5.	June 12.	June 19.	AGGREGATE. Wks.	1915.	Increase or Decrease.
	£	£	£	£	£	£	£	£		£	£
Anglo-Argentine	55.557	54.921	58,655	55,745	53.580	51.984	50.398	50,758	24	1,235.237	−116,356
Auckland	(28 days)	20.919	...	...	(28 days)	20,511	...	...	48½	,248.109	+ 798
Burma Rs.	4,439	5.352	4,779	4,746	4.060	4.087	4.516	4.156	...	...	− 43,409
Calcutta Rs	62,792	65,830	65.404	64,846	62,425	64.050	63.343	64.209	25	1,583,090	− 87,836
Hong Kong $	12.093	12.474	11.008	12.246	9.488	10.902	10.565	10.826	25	263.766	− 29.250
Madras Rs.	27.766	(14 days)	28.000	(14 days)	29.228	(14 days)	27.340	(14 days)	23	313.655	− 4.327

Companies Issuing Monthly Statements.

	1914. Jan	Feb.	March.	April.	May.	June.	1915. Jan.	Feb.	March.	April.	May.	June.	Wks.	AGGREGATE. 1915.	+ or −.
	£	£	£	£	£		£	£	£	£	£			£	£
Brazilian Street Mlrs.	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
BrazilianTraction Mlrs	6.194.227	5785027	6153984	5.941.220	...	...	5.996.190	5797500	6294910	6.333.460	...	...	17	24.422.060	+ 347.602
Brisbane	28.330	25.260	28.325	28.610	29.860	...	29,620	26.590	30.740	29.890	31.780	...	21	148.620	+ 8.235
British Columbia $	777.102	704.003	717.251	698.508	678.314	...	640,495	558.512	557.135	540.861	512.568	...	47	6.808.470	−1.320.434
Buenos Aires Pt. & C.	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Buenos Ayres Lacroze	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Cape Town	14.646	13.342	13.922	13.408	...	...	15.660	13.924	15.829	14.512	...	...	17	59.925	+ 4.607
Carthagena& Herrerias	2,776	2,919	2,425	2.069	2.202	1.405	904	1.822	2,436	1.496	1.931	2.059	26	10.648	− 3.148
Cordoba	...	...	...	13.406	14.667	...	...	...	...	13.607	14,458	...	9	28.065	− 8
East India	1.938	1.701	1.884	1.837	1.885	...	1.914	1.649	1.846	...	2.119	...	43	19.359	+ 235
Kalgoorlie	2.340	2.169	2.476	2.820	...	...	2.372	2.352	2.638	2.841	...	...	17	10.203	+ 398
La Plata	5.296	4.766	5.178	4.716	4.727	...	4.540	4.016	4.582	4.269	4.489	...	21	21.896	− 2.787
Lima	37.870	33.779	34.665	34.153	...	...	33.042	30.173	34.180	31.615	...	...	17	129.010	− 11.457
Manila $	137.000	153.300	137.200	134.300	138.600	...	127.500	123.000	119.984	117.450	120.475	...	21	609.196	− 91.873
Melbourne	68.500	64.000	63.000	...	...	...	62.729	59.086	64.506	...	...	...	13	186.321	− 9.179
Mexico $	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Montevideo	38.256	35.805	32.630	29.650	29.016	...	32.443	30.007	29.716	26.786	27.771	...	30	202.426	− 26.771
Port Elizabeth	4,830	3,510	4,535	3.758	...	...	4,102	3,149	3,346	3.371	...	...	17	13.968	− 2.665
Puebla $	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Rangoon	5,163	5.009	6,475	5.367	5.323	...	4.689	4,991	5.217	4.964	4.887	...	21	24.748	− 2.589
Toronto $	847.945	777.683	836.328	830.299	871.733	...	843.351	767.326	820.750	795.816	795.262	...	21	4.022.505	− 141.483
Winnipeg $	382.670	350.977	347.812	337.414	337.664	...	350.681	314.658	303.209	264.856	263.302	...	21	1.496.707	− 259.832

(*Continued on page 48*)

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TRAFFIC RETURNS—*continued.*

Tramways and Omnibus Undertakings in the United Kingdom.

NAME OF COMPANY OR CORPORATION.	1914. WEEKS ENDED.				1915. WEEKS ENDED.				AGGREGATE.			
	May 30	June 6	June 13	June 20	May 29	June 5	June 12	June 19	Wks.	1915.	Increase or Decrease.	
	£	£	£	£	£	£	£	£		£		£
Aberdeen Corporation	2.797	...	2.390	1.790	3.132	...	2.458	1.866	2	4.324	+	143
Accrington Corporation	559	702	599	612	728	593	533	551	11	6.198	−	573
Ayr Corporation	335	399	402	451	322	336	365	440	5	1.798	−	180
Bath Electric	*	...	...	...	...	...	...	...	—	—		—
Birkenhead Corporation	1.223	1.396	1.259	1.264	1.527	1.372	1.412	1.401	11½	15.607	+	462
Birmingham Corporation	12.538	14.202	12.576	12.875	14.955	12.733	13.202	13.160	12	150.102	+	1.448
Blackburn Corporation	1.715	1.198	1.197	1.440	2.007	1.245	1.295	1.371	12	15.730	−	804
Blackpool and Fleetwood	487	2.027	991	904	1.479	878	622	648	24	10.925	−	2.014
Blackpool Corporation	778	3.729	2.278	1.607	2.511	2.278	1.116	1.202	12	14.197	−	3.476
Bolton Corporation	2.742	3.064	2.978	2.847	2.605	2.818	2.832	2.824	12	30.642	−	3.588
Bournemouth Corporation	2.779	2.065	2.099	2.170	2.005	2.004	2.079	2.009	12	25.631	−	18
Bradford Corporation	5.920	7.661	6.292	6.450	8.639	6.400	6.772	6.524	12	76.809	+	1.316
Brighton Corporation	1.090	1.293	1.101	1.118	1.291	1.030	1.122	1.130	11½	12.145	−	720
Bristol	8.370	12.306	8.855	9.757	13.767	10.246	9.737	9.904	24½	220.279	+	20.346
Burnley Corporation	1.551	1.996	1.609	1.607	1.957	1.565	1.544	1.528	12	19.153	−	2.876
Burton-on-Trent Corporation	298	320	303	301	315	281	295	282	12	3.300	−	266
Bury Corporation	1.319	1.544	1.475	1.381	1.664	1.488	1.393	1.390	11½	16.245	−	495
Cardiff Corporation	2.679	3.489	2.937	2.937	3.250	2.643	2.825	2.777	11	30.871	−	2.823
Chatham and District	830	1.181	880	981	1.473	1.182	1.316	1.243	24	25.862	+	4.481
Chesterfield Corporation	246	346	250	266	352	255	262	263	11	2.939	−	327
Colne Corporation	275	359	279	302	395	240	262	258	—	—		—
Cork Electric	505	539	499	593	618	536	554	571	24	11.515	−	167
Croydon Corporation	1.644	2.220	1.678	1.792	2.252	1.719	1.966	1.980	11	21.047	+	148
Darlington Corporation	251	290	264	264	291	252	260	249	11½	2.942	−	96
Derby Corporation	989	1.277	1.021	1.064	1.327	1.016	1.071	1.030	11½	12.087	−	196
Dover Corporation	222	304	224	236	360	300	308	301	11	3.424	+	617
Dublin and Lucan	145	231	141	180	249	187	160	190	24	3.401	+	130
Dublin United	5.651	6.979	5.942	6.916	7.472	6.226	6.389	6.643	24	143.127	+	6.822
Dundee City	1.276	1.399	1.331	1.370	1.358	1.350	1.384	1.398	4½	6.155	−	15
East Ham Corporation	1.001	1.217	1.098	1.123	1.410	1.245	1.376	1.351	11½	15.229	+	2.994
Exeter Corporation	331	468	352	379	498	373	416	394	11	4.272		—
Gearless Motor 'Buses	*	...	...	...	...	...	...	...	—	—		—
Glasgow Corporation	21.946	22.232	21.824	22.074	22.819	22.821	22.802	22.930	3	62.936	+	3.399
Glossop (Urban Elec. Supply Co.)	115	127	126	135	157	129	136	131	25	2.935	−	148
Halifax Corporation	2.045	3.132	2.165	2.346	3.362	2.097	2.284	2.292	11	24.990	−	211
Hastings and District	962	1.385	985	1.128	1.315	940	957	1.010	24	20.004	−	956
Huddersfield Corporation	2.161	1.880	2.348	2.549	3.883	2.587	2.768	2.674	12	31.394	+	3.066
Hull Corporation	2.966	3.325	3.085	3.083	3.311	3.001	3.406	2.960	11	35.394	−	1.252
Ilford U.D. Council	460	674	538	597	801	643	690	673	11	7.518	+	1.531
Ilkeston Corporation	156	121	131	141	119	135	132	138	12	1.545	−	64
Ipswich Corporation	435	600	464	620	680	538	586	571	11	5.719	+	249
Isle of Thanet	585	978	709	880	588	412	413	408	37	11.993	−	4.047
Kilmarnock Corporation	166	167	170	172	159	169	165	173	5	837	−	84
Lanarkshire	1.911	1.981	1.912	2.012	2.093	1.945	2.093	2.105	24	44.054	−	1.708
Lancashire United	1.569	1.866	1.766	1.811	2.102	2.115	1.777	1.892	24	39.484	+	382
Leeds City	8.128	10.097	8.567	8.961	11.651	8.808	9.381	9.188	12	103.541	+	4.561
Leicester Corporation	2.893	3.466	2.962	3.089	3.878	2.987	3.252	3.111	25	71.660	+	1.045
Leith Corporation	740	774	743	790	799	787	816	791	5	3.979	+	133
Leyton U. D. Council	1.330	1.767	1.387	1.478	1.846	1.324	1.626	1.635	11	17.642	+	1.744
Liverpool Corporation	13.499	14.279	13.311	13.888	15.371	13.562	13.928	13.934	24	314.853	−	3.149
Llandudno and Colwyn Bay	257	705	415	375	541	392	358	390	28	7.264	+	877
London County Council	43 762	47.346	42.788	43.837	12.610	23.586	41.087	44.012	11	440.966	−	46.812
London General Omnibus	*	...	...	...	...	...	...	...	—	—		—
London United	*	...	...	...	...	...	...	...	—	—		—
Lowestoft Corporation	197	265	206	216	213	171	186	167	37	6.949	−	760
Maidstone Corporation	190	272	188	211	275	196	212	203	11	2.439	−	77
Manchester Corporation	17.556	18.919	17.780	18.869	21.197	18.493	18.348	18.405	11	207.608	+	365
Metropolitan Electric Tramways	*	...	...	...	...	...	...	...	—	—		—
National Steam Car	*	...	...	...	...	...	...	...	—	—		—
Nelson Corporation	267	231	195	223	281	174	197	186	11½	2.231	−	350
Newcastle-on-Tyne Corporation	5.134	5.430	5.130	5.278	6.531	6.269	6.451	6.546	11	71.090	+	10.366
Newport (Mon.) Corporation	792	1.042	834	828	1.043	802	870	852	12	9.588	−	294
New St. Helens and District	816	1.229	821	913	1.578	1.054	1.018	1.129	50	47.227	+	5.414
Northampton Corporation	544	790	572	622	1.074	734	787	774	11	8.559	+	1.623
Nottingham Corporation	3.290	4.204	3.422	3.561	4.473	3.494	3.768	3.717	11	40.570	+	485
Oldham Corporation	2.287	2.288	2.487	2.321	2.712	2.428	2.323	2.402	13	29.148	−	609
Portsmouth Corporation	2.076	3.002	2.835	2.402	3.177	2.548	2.631	...	11	26.898		—
Preston Corporation	810	1.162	823	897	1.249	888	932	939	11	10.475	−	382
Provincial	1.804	2.744	2.026	2.049	2.957	2.302	2.375	2.438	11	75.726	+	8.005
Reading Corporation	659	894	696	767	978	733	802	818	11	8.652	+	481
Rhondda Tramways	1.163	1.643	1.272	1.175	1.567	1.215	1.164	1.203	24	27.858	−	1.820
Rochdale Corporation	1.553	1.808	1.629	1.648	2.255	1.896	1.706	1.771	11½	20.218	+	681
Rotherham Corporation	1.058	1.044	1.007	1.009	1.126	1.147	1.143	1.139	12	13.376	+	1.146
Salford Corporation	5.171	6.449	5.300	5.420	6.306	5.205	5.437	5.402	11½	61.749	−	509
Sheffield Corporation	7.832	9.060	7.811	7.866	9.678	8.648	8.824	8.767	12	106.732	+	7.347
Southampton Corporation	1.260	1.657	1.358	1.418	1.800	1.414	1.477	1.525	11	15.918	+	674
Southend-on-Sea Corporation	918	1.425	1.017	1.061	1.134	755	750	737	11	9.062	−	2.183
South Metropolitan Tramways	*	...	...	...	...	...	...	...	—	—		—
South Shields Corporation	742	943	762	805	932	766	799	889	11½	8.974	+	114
Sunderland Corporation	1.425	1.838	1.510	1.513	1.678	1.430	1.559	1.501	12	16.928	−	465
Sunderland District	575	814	559	596	870	528	543	578	33	18.042	−	1.157
Swindon Corporation	165	220	174	179	241	197	206	214	11	2.182	+	197
Torquay Tramways	532	825	618	649	805	545	553	548	24	11.832	−	441
Tramways (M.E.T.) Omnibus Co.	*	...	...	...	...	...	...	...	—	—		—
Tyneside Tramways and Tramroads	522	721	522	590	878	610	660	808	24	13.515	+	700
Wallasey Corporation	1.257	1.641	1.302	1.398	1.668	1.271	1.323	1.347	11½	14.523	−	799
Walsall Corporation	616	842	594	615	1.028	692	742	755	24	16.974	+	1.489
Walthamstow U.D. Council	1.099	810	810	974	1.242	887	987	1.002	12	10.568	+	875
Warrington Corporation	438	471	438	446	492	455	458	461	11	4.970	+	20
West Ham Corporation	2.780	3.259	2.768	2.881	3.483	2.837	3.205	3.213	11	34.812	+	2.368
Wigan Corporation	1.519	1.780	1.427	1.491	1.822	1.492	1.473	1.546	11	17.100	−	394
Wolverhampton Corporation	1.662	1.023	1.070	1.039	1.022	1.076	1.077	1.085	12	13.228	−	214
Yorkshire (West Riding)	1.487	2.008	1.401	1.401	2.372	1.643	1.602	1.605	25	38.435	+	2.065

* TRAFFIC RETURNS SUSPENDED.

Owing to the European war, the Government have taken over the railways of Great Britain as from August 4, and the issue of traffic returns has been suspended. Consequently the traffic returns of the electric railways which usually appear on this page cannot be given.

The Publication of the Traffic Returns of the Tramways marked with an asterisk in the above table have also been suspended during the war.

TRAMWAY DIRECTORIES.

A useful feature of this issue is the directory of electric railways and electric tramways which will be found among the advertising pages. This directory contains the names of the chief officals and the principal particulars relating to each undertaking.

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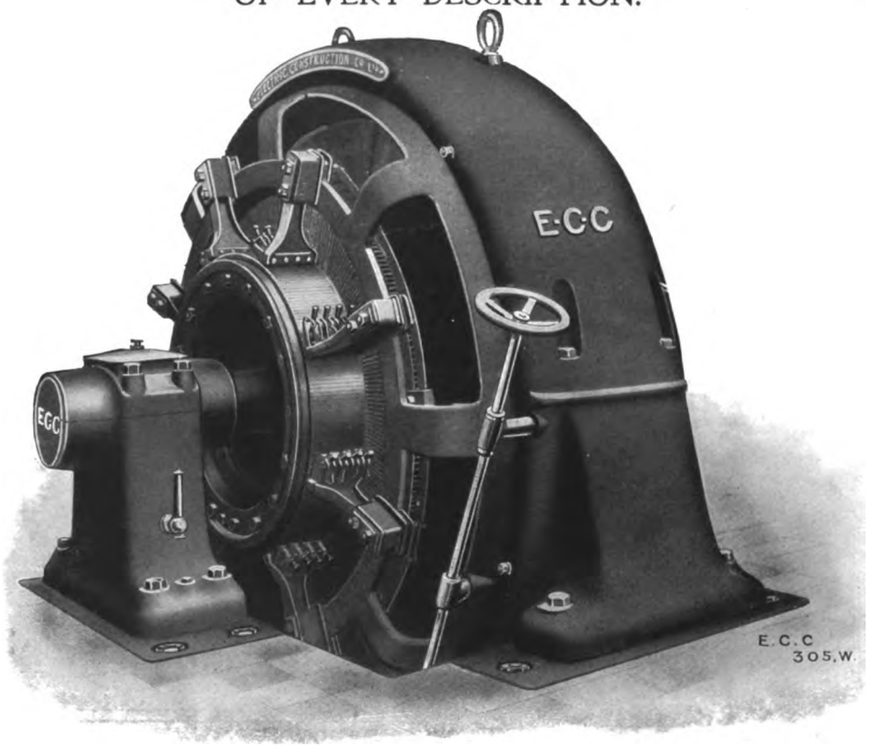

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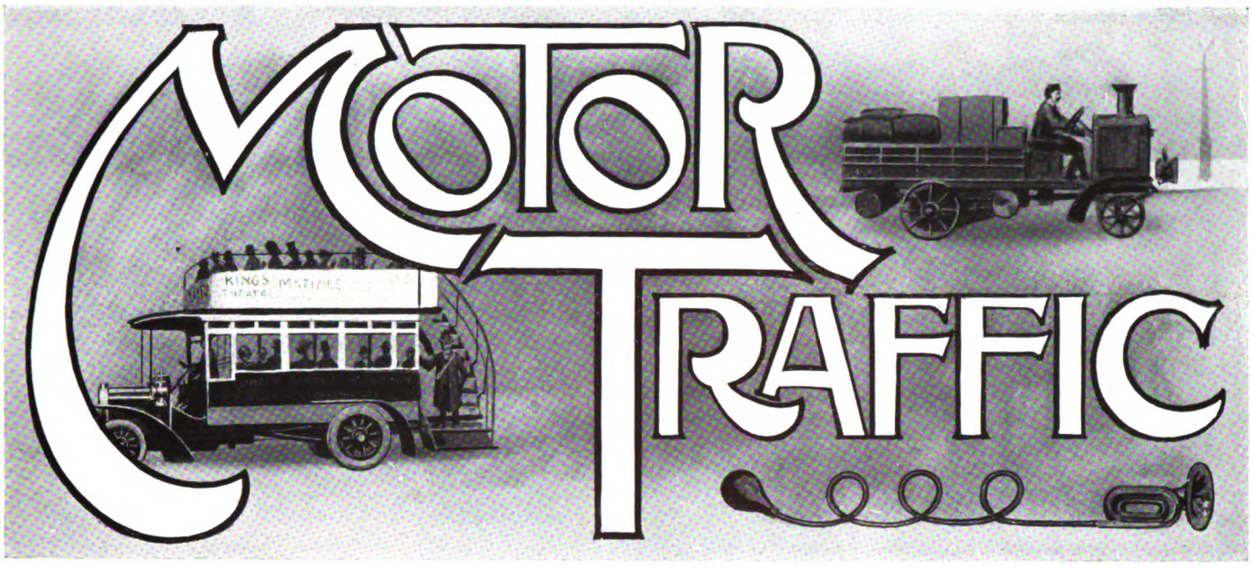

A good deal of significance is hidden behind the very short and bald statements contained in the R.A.C. official report of a trial of "Natalite" motor spirit. This report serves to show merely that the spirit, consisting mainly of a compound of alcohol and ether, gave satisfactory running in an ordinary petrol engine under normal road conditions. The engine started easily on all occasions, the exhaust was inclined to be maladorous, and the valve caps and valve heads were found to be very clean after the trial. The results did not afford any ready means of comparing fuel consumption with that given by petrol in the same car. Nor does the official statement make clear the most important point of all, which is that "Natalite" is a fuel wholly manufactured from crops which can be grown year by year in any required quantity. It is a true alcohol fuel, inasmuch as it is entirely independent of mineral supplies. Neither is it really a mixture, since ether is a derivative of alcohol, and the whole process of manufacture of all the components of the fuel is carried on within an alcohol distillery. Doubtless, it would be quite feasible to mix "Natalite" with benzole. One would imagine that the result would be a very effective fuel, and that the rather dirty tendency of benzole would be neutralised, and the difficulty of starting on a cold morning overcome. "Natalite" is not primarily intended, however, to be used as part of a mixture. The present writer has tested the fuel in a petrol car on the road, and has found the economy of consumption quite the equal of petrol, and the acceleration and hill-climbing abilities of the car unaffected, if not absolutely improved. The exhaust—officially described as inclined to be maladorous—is certainly not sufficiently so to constitute a serious drawback.

* * *

As to the cost at which "Natalite" can be produced, it is early as yet to speak. We are informed that its manufacture from molasses or other suitable raw materials is only very slightly more expensive than the manufacture of ordinary industrial alcohol. The cost of the raw materials is very low, since they are at present practically waste products, and until the demand becomes extremely large, it will not be necessary to cultivate crops specially for the purpose of converting them into fuel by this process. At the moment, enormous quantities of molasses are run to waste, and there are immense possibilities of the utilisation of vegetable crops of no market value, but of extremely prolific habit. Those who make a point of opposing any suggestions which favour the use of alcohol as a fuel will no doubt put up their two stock arguments in this instance also. One of these arguments is that legal restrictions are insurmountable; the other, that alcohol crops cannot be cheaply grown in England, and therefore the whole subject is of no direct interest to us. As to the first point, legal restrictions are not necessarily permanencies. We have had very strong hints to the effect that when the fuel and the engine together have reached a sufficiently advanced stage of development, all possible help will be given by the removal of regulations which, while perhaps justifiable in the meanwhile, would then be standing in the way of progress. Moreover, we may expect the Governments of younger countries—such as our oversea Dominions—to be more easily amenable in such matters, and to do their best to encourage an industry capable of big development within their own boundaries.

* * *

As to the second objection, it may be admitted immediately that Great Britain is not an ideal land in which to grow alcohol crops, which require a large measure of sunshine. The time may come when alcohol fuel will be imported from the Colonies at a price which will compare with that of petrol. Meanwhile, the great point is that everything should be done to render the Dominions and Colonies themselves independent of imported fuels. Home-grown alcohol fuel will represent to them a great saving in operating costs as well as a new agricultural industry. If, by creating their own supplies, the Dominions cease to be dependent upon petrol, the natural consequence is that larger stocks of the latter are freed for consumption upon the British home market. Here, we have a tendency towards keeping down prices, and a similar influence would be exerted by the presence somewhere on the world's markets of a fuel which—were the price of petrol to go too high—could be successfully imported even into countries where it cannot be economically grown. Whatever may be the future of "Natalite," its arrival appears to us to be an event of the greatest importance, since it is the first time an alcohol fuel has shown itself capable of competing on equal terms with petrol on what may be called the latter's own ground, that is, in an engine the design of which has not in any way been modified.

If the country were not engaged in war it is probable that the recent strike of London County Council tramway employees would strongly accentuate the feeling that prevails among large numbers of ratepayers

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MOTOR TRAFFIC.

in favour of placing that undertaking under the control of some independent body organised on a plan similar to the Metropolitan Water Board. For all that the general body of the public seem to care the transference might be made without any protest, especially in view of the gain to the rates in the form of rent, in lieu of the call upon the ratepayers that is bound to come if competition continues to reign unchecked. One cannot witness the patronage bestowed upon the omnibuses running on tramway routes without coming to the conclusion that the passengers, who include many ratepayers, entertain but little thought of the financial difficulties in which their action may involve the tramways. They are satisfied with a vehicle which on wood-paved sides of tramway routes gives a faster average speed, with fares as low as the tramcars for single journeys, the exceptions being the return tickets and the absurdly low workmen's fare.

* * * *

The question may be asked whether the leasing of the tramways would ensure freedom from labour troubles. The answer may be returned to the effect that although under the present scale of fares the limit has been reached in concessions to employees, it is possible that by the limitation of the existing competition and a reversion to fares that have been unreasonably reduced in consequence of the rivalry the financial results would be improved to such a degree that reasonable requests could be listened to. There would also be a decrease in the calls made upon the tramways for track paving, and upon borough councils for the paving of the remainder of the road. The streets would be rendered safer for foot passengers, with a consequent decrease of the amount of money now paid out as compensation for personal and vehicular accidents by both the County Council and the omnibus companies. When the London County Council tramways have so much to gain by lessening competition, it is surprising to find its Parliamentary Committee a few weeks ago using extravagant language in their report upon the Electric Railways Companies Facilities Bill. This has been introduced into Parliament for the purpose of securing further interchange of traffic between the Underground Railways and the London General Omnibus Company, and for the payment into a common fund of the balances of the companies' revenue after providing for rents, interest on debentures, etc. The Committee suggests that if the Bill is passed it will become possible for the companies to effect economies by closing or restricting the service on the less remunerative route in cases in which public benefit arises from the existence of alternative and to some extent competitive routes. Such a plea indicates a lack of common sense, which is particularly to be deplored in the party which has been returned to conduct the business of the ratepayers on just lines, and to avoid wasteful methods. The Committee is within its right in asking the Council to declare that the Bill should not become law unless accompanied by adequate safeguards, but they have no claim to insist that shareholders' money shall be squandered on the maintenance of competitive services.

* * *

Now that the Institution of Automobile Engineers has adjourned until next winter its useful work of discussing papers prepared by the members, it is interesting in view of the war to glance at the proceedings of the session. First, the membership must be credited with having performed something more than pen or lip service in connection with the European conflict. At an early stage the Institution was able to lay before the War Office the names of a large number of its members suitable for positions in the Mechanical Transport department, and over 150 members are now serving with the Forces. Their services may be said to be indispensable, for, thanks to their exertions at the base and advanced posts, vehicles are kept running without the necessity in many cases of sending them to the makers in Great Britain. Others are engaged in the work of inspecting new vehicles and upon repairs to old machines. Besides serving in various military transport capacities, the members of the Institution are to be found in the Royal Flying Corps, in the Anti-Aircraft Battery, and various other corps. Colonel Holden, the president-elect, is holding the position of Director of Mechanical Transport at the War Office, Lieut.-Colonel Donohue is working as chief inspector of mechanical transport in Great Britain, while Captains Critchley and Brewer are engaged in important work for the War Office in America. The rough usage undergone by transport vehicles during the past eleven months has proved a valuable factor in increasing the knowledge of engineers, for defects, etc., develop in a few months that at other times would require a year or more to become evident. The experience acquired in this respect will no doubt find expression in some of the eight papers that have already been promised for next session. Last winter the war necessitated a careful revision of the programme, and the papers were arranged to deal as far as possible with the difficulties caused to automobile engineers by the war in obtaining a supply of steel castings, forgings, etc. Mr. H. L. Pomery read two valuable papers entitled "Automobile Engineering and the War," and "Automobile Manufacturing and the War," in which the difficulties were clearly set forth and the remedies suggested. In January Mr. T. Clarkson read a welcome contribution dealing with the supply of steel wheels for commercial vehicles, which should bear fruit in bringing about improved methods of manufacture in this country in lieu of wheels and parts hitherto imported from the enemy. This has already been accomplished in the matter of magnetos by several manufacturers, and a very helpful paper on the subject of the supply of magnetos, and suggestions in regard to their design, was read by Mr. J. F. Henderson at the February meeting. Then followed two exceedingly acceptable papers on aeronautical subjects by Mr. F. W. Lanchester, and the session was brought to a close by a practical paper by Mr. A. Stubbs on the subject of stampings for the automobile industry. Arising out of the paper by Mr. Pomeroy, a committee was formed consisting of steel makers, stampers, and automobile engineers, and this body has been sitting throughout the winter considering the question of the drawing up of standard specifications for the steels necessary for use on automobiles. The result of their deliberations will be communicated to the Engineering Standards Committee.

THE ELECTRIC VEHICLE COMMITTEE.—This committee has sent a request to the special committee of the Local Government Board on motor traffic asking that evidence be heard with regard to the effect of the use of electric vehicles. The Secretary will give evidence if the application is granted. The committee have decided to communicate with the representative electrical institutions in the Colonies suggesting the advisability of adopting the committee's standards in regard to electric vehicles.

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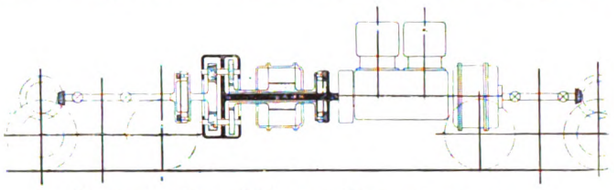
MOTOR TRAFFIC.

THOMAS TRANSMISSION COACH FOR NEW ZEALAND.

A demonstration of a 200 H.P. rail coach built to the order of the New Zealand Government, and designed throughout by the Thomas Transmission, Limited, was given in Birmingham on June 17 when the coach was inspected by a large number of railway and Government officials. Considerable attention has been given during recent years to the application of the internal combustion engine to railway work. Although but comparatively little progress has been noticed, it is shown by the results obtainable from the latest example of the Thomas Transmission system as applied to a locomotive coach, that the advancement has been very real, and that practical advantages of a high order are now possible. The case for the self-propelled rail coach is a strong one, for by this system alone it is possible to give frequency to a service on branch lines and sparsely populated districts, where financial reasons prohibit electrification. The question of its use for main line work under certain conditions is also of importance, for with an improved system of transmission the possibilities are very great.



Power System of Thomas Transmission Coach shown diagrammatically.

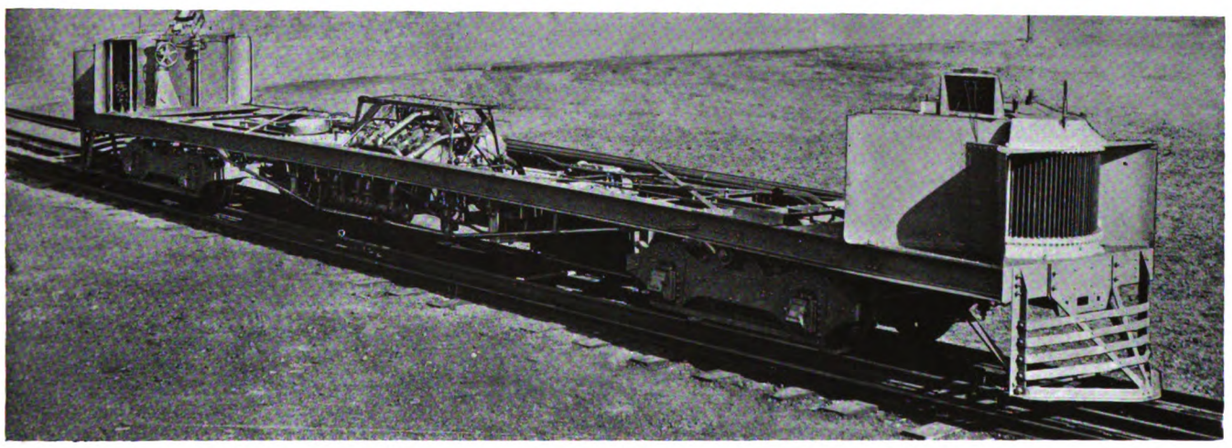
The difficulties appertaining to rail traction are quite distinct from those which have been overcome in the commercial road motor, and herein lies the cause of the slowness of development in the former case. For railway work loads are enormously greater and speeds very much higher, so that it is clear that success chiefly depends upon the perfection of the power unit. Great strides have recently been made in the development of the high-power internal combustion engine, and the 200 H.P. motor fitted to the New Zealand coach constitutes a machine which is a great advance upon anything previously seen for traction purposes.

In the latest locomotive coach the outstanding feature is the transmission. The principle of Thomas transmission has been described fully in past issues of this journal, and many readers are familiar with it. Briefly it may be stated that the system comprises the use of two electrical machines (each about one-third the normal horse-power of the prime mover) and a planetary gearing, which interconnects these electrical machines with the engine and the load. On top speed all the power is transmitted direct mechanically, and in starting and climbing heavy grades part of the power is transmitted mechanically and part electrically. It is this automatic division of the power at these periods and the direct drive on top speed that provides the extraordinary flexibility and efficiency which is claimed for the Thomas transmission system.

Conditions of service specified by the New Zealand railway officials are exceptionally severe. The coach is required to carry fifty passengers and haul a 25-ton trailer up a grade of 1 in 40 at fifteen miles per hour, the gross load being about 60 tons. The maximum speed on the level will be just over 40 miles per hour, and it is estimated that the vehicle will haul a gross load of 85 tons up the 1 in 40 grade at about ten miles per hour. The coach alone will take the specified grade at a speed of 28 miles per hour. The vehicle shown at Birmingham was not fitted with the body, as this is to be manufactured and fitted at the New Zealand Government Railway's workshops in Wellington.

In ordinary service it is understood that the vehicle will haul two 25-ton trailers, each carrying its full complement of passengers, the total number on the train being 150. Although in the main the equipment is similar to that of the vehicle supplied to the South African railway by Leyland Motors, Limited, some three years ago (described in our issue of August 11, 1911), practical experience with the running of that vehicle has suggested improvements in connection with the details of the transmission itself. In the case of the South African Railway coach, the planetary gearing is located inside the flywheel, but this had the disadvantage that the large sun wheel shaft driving the mechanically driven bogie had to pass through the hollow shaft connected to the small sun wheel, and universal joints had to be interposed in both these shafts between the flywheel and the first electrical machine.

In the New Zealand coach the chief improvement to be noted is the location of the planetary gearing. From the accompanying plan of the transmission it will be seen that this is now disposed on that side of the first electrical machine remote from the engine, so that only one driving shaft and one flexible coupling are required. The whole of the parts, including the flexible coupling, magnetic clutch (which locks the gearing), the first electrical machine, the planetary gearing, and the free-wheeling magnetic clutch now form one complete unit, which is known as the "transmission unit."



200 H.P. Chassis of Thomas Transmission Coach.

Another important improvement lies in the adoption of magnetic clutches. In the case of the South African Railway coach the top speed clutch took the form of an ordinary claw coupling, and although this gave a very positive drive, it had the disadvantage that it was not absolutely "fool-proof," as all the members of the gearing had to attain exactly the same speed before it was possible to engage the clutch. No free-running clutch was provided, although a dog clutch was inserted in the mechanical drive in order to disconnect the drive when the vehicle was stationary. Specially designed magnetic clutches appear in the New Zealand coach, and are in every way satisfactory. They are controlled by a small hand switch, which is operated by the driver in exactly the same way as the driver of a motor car uses the clutch pedal.

Other improvements connected with the design of truck, method of control, disposition of radiators, etc., are also of importance. In a subsequent issue we shall give a more detailed description.

STRAKER-SQUIRE LORRIES IN EGYPT.—A motor transport driver attached to the New Zealand contingent in Egypt writes of the "wonderful satisfaction" which the Straker machines are giving. His vehicle is frequently loaded with nearly double the weight it is constructed to carry, and is operating over very bad roads, but it has not required any shop attention.

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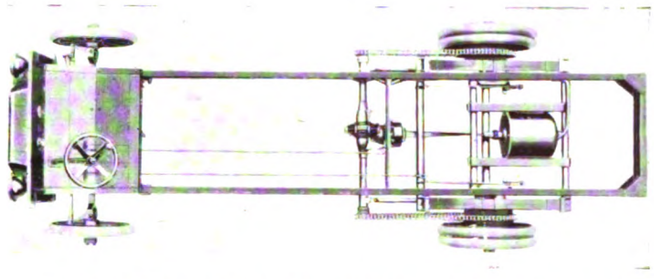
MOTOR TRAFFIC.

THE USE OF ELECTRIC VEHICLES IN MUNICIPAL SERVICE.*

By F. Ayton,
Honorary Secretary to the Electric Vehicle Committee.

There could hardly be conceived a more suitable field for the employment of the electric battery vehicle than that connected with municipal service. This is because the work to be done lies entirely within the proper sphere of this particular type of vehicle, viz., short distance haulage at moderate speeds. The mileage capacity



Typical Electric Vehicle Chassis showing the Simplicity of the Mechanism.

per charge, i.e., 35 to 45 for the heavier vehicles, is sufficient for practically every duty which the municipal vehicle has to perform, but by a mid-day boosting charge the daily mileage may be considerably increased. In fact, the only limit to the daily mileage is the time required to charge the battery.

Wherever the electric has been employed in its legitimate sphere, the claim of economy has been proved to the hilt. In citing evidence in support of this statement attention may be directed to the experience of Glasgow, where the electricity department found that their first electric van, of one ton capacity, did the work of two horses at a saving in expense and with greater efficiency, while, compared with a petrol van, which the department was previously using, the electric did the same work with a saving of £240 per annum. Other evidence is afforded by the refuse collection trials at Barnes and at Heston and Isleworth, while the instance of Calgary provides an additional illustration of the financial advantages, the daily saving, as against horses, by the operation of two watering and flushing vans being given as about £5. Outside municipal service we have the case of Harrod's Stores. This firm operates 55 delivery vans, and state :—" We find them cheaper than horses."

The durability of the electric vehicle is a feature not to be lost sight of, and there is justification for putting the average life of a modern vehicle of good make at not less than ten years. An American firm of goods carriers, having depots and delivery vehicles in all the principal cities, wrote to the committee last year in regard to their experience with electric vehicles, stating, among other things, that " the first cars purchased in 1904 and 1905 are still in daily operation without unreasonable expense or unduly high charges." This company owns 375 " electrics."

Reliability is another feature, for experience has shown that this type of automobile can keep the road for more days in the year than any other type. It is safe to estimate, in the case of a fleet of electric vehicles, that the average working days in a year for each machine will be not less than 97 to 98 per cent. of the maximum possible. The reasons for this are the simplicity of the mechanism, the strong construction possible on this account, and the fact that, owing to the simplicity and fewness of the working parts, any repair or replacement can usually be effected during the night, or in such a short time as not to interfere with the use of the vehicle. The net effect is that, where several vehicles are operated, fewer spare ones need be kept than if petrol or steam machines were employed.

The modern electric battery vehicle's utility and reliability, as well as its unique economy, are attested by the fact that upwards of 70,000 are in use in the United States. The advantages which the type possesses from the point of view of public health and civic amenities are alone sufficient to warrant its adoption by municipalities. In the case of those municipalities that own electric supply undertakings, there is a further reason why they should set the example as users, and that is the important new source of revenue which the general use of electric vehicles in any district will open up. The demand in connection with it need never come on during " peak-load " hours ; hence it may be dealt with without requiring additional expenditure in plant, buildings, or mains. Moreover, as its effect will ever be to even out the load curve and so lead to greater economy in the cost of generation, this will in time permit of a lower rate being charged to all other classes of consumer.

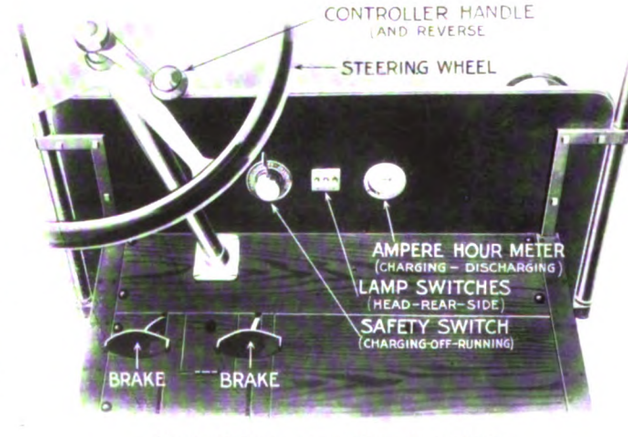
Refuse Collection, Electric Supply, Ambulance, and Fire Brigade Work.

Delivery vans are now in use or on order by the electric supply departments at Glasgow, Edinburgh, Derby, West Ham, Croydon, Blackburn, Bootle, Hereford, Ipswich, Grimsby, Brighton, Wolverhampton, Southampton, Liverpool, and the Councils of St. Marylebone, Stepney, and Poplar. The report gave particulars of the capital cost, mileage, and low working cost of the vehicles in use at the foregoing places, and went on to refer to the economy anticipated from the utilisation of 100 electric refuse carts by the Paris municipality, and to the satisfactory results obtained from trial vehicles for the same purpose at Barnes, Isleworth, Birmingham, and Dover. As the result of the trials four refuse vans had been ordered for Barnes, two for Birmingham, and six for Dover.

By reason of its smooth and silent running, the uniform and jerkless acceleration, the electric is an ideal vehicle for ambulance work. In regard to the City Police Ambulances, Captain Sir J. W. Nott-Bower, the Commissioner of Police, informs the committee as follows : —" The electric motor ambulance service was commenced in May, 1907, with one electric ambulance. In May, 1909, a second ambulance was obtained, and both have proved very satisfactory indeed for removing cases of accident or illness in the streets to hospitals. The initial cost of the ambulances, with surgical fittings, was, approximately, £569 and £552 respectively, and the total cost of the service is, approximately, £2,000 per annum. The cost of working is about 5·1d. per car-mile, including expenses such as tires, necessary repairs to cars, charging of batteries, etc., but excluding wages and rent. Tire costs account for about 2¼d. in the cost mentioned per mile. Another ambulance is now being obtained from the Cedes Electric Traction Company, Limited, and will be taken into use shortly."

The Secretary of the Port of London Authority states that :—" The Authority possesses four electric motor ambulances, and these have been in use since September, 1912. They have been found quite suitable for the conveyance of injured persons to hospital with promptitude and comfort."

Electric battery vehicles have been in use to a considerable extent for fire brigade work. Notable examples are London and Liverpool ; while up to the outbreak of war they were known to be employed in several continental cities, one having 24 in use. Several towns



Control Gear of an Electric Vehicle.

and cities in the United States employ electrically-propelled fire engines and escapes.

Ease of Operation and Promptness of Action.—Unlike the petrol-driven type, there is no preliminary starting of the engine before the vehicle itself can be got on to the move. All that is necessary is for the driver to get on the seat, throw off his brake, move the controller, and the vehicle is under way. That this feature secures a promptness in answering calls is fully confirmed by the experience of the London Fire Brigade, which possesses 15 electrically-propelled vehicles, the oldest having been put into commission in 1911.

* Abstract of a report by the Electric Vehicle Committee presented on June 17 at the Convention of the Incorporated Municipal Electrical Association.

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At a discussion upon electric vehicles at the Institution of Electrical Engineers on March 19, 1914, Lieutenant Sladen, R.N., Chief Officer of the London Fire Brigade, referring to the feature mentioned above, said :—"Among the advantages of electric vehicles for fire brigade work, we find that they require repairing less frequently, and that the rapidity of turn-out is absolutely unequalled by any other form of traction ; it is not uncommon at an electric motor fire station under ordinary service conditions for a turn-out to be effected in seven or eight seconds, whereas with other forms of motors a good turn-out is perhaps 15 seconds. That is a very good point, especially for the life-saving appliances."

5-Ton Dray of an Ipswich Brewery.

Liverpool Brigade has had four electric vehicles in use since 1907. Three of them weigh about 6 tons, while the fourth scales 2½ tons ; all four have a speed of 20 miles per hour on the level, and a mileage capacity on one charge of 30. Mr. A. W. Weir, the Chief Superintendent, writes in regard to these vehicles :—" They have given every satisfaction, and are inexpensive to run, the cost working out at 2½d. per mile."

Reference was next made to the advantages of electrical vehicles for the general work of upkeep and cleansing of streets and roadways. The saving stated to result from employing " electrics " in place of horse-drawn vans for this purpose by the municipality of a continental city is about £80 per electric van per year. The electric vehicle is also employed for carrying materials used in the making and repair of roadways, and a 3-ton wagon with tipping body has just been put into service for this purpose by the Corporation of Ipswich. In reality, this wagon will be a " double-purpose machine," since the tipping body is removable, and can give place to a water-tank (which is now being constructed) to enable the vehicle to be used for street watering.

Omnibuses Used by Tramway Departments.

There are now three tramways undertakings making use of the electric battery omnibus as an adjunct to their tramway services, i.e., Southend-on-Sea, South Shields, and York. In all three instances it is understood that the vehicles are giving satisfaction. Apart from the features of economy, silent running, general cleanliness, and simplicity, a strong argument for the adoption of electric vehicles, as against petrol or steam driven ones, by a tramways department is that their use entails no augmentation of the repair staff by specially experienced men, because the equipment, except the battery, being similar to that upon a tramcar, the ordinary repair staff can quite easily do all repairs needed.

South Shields Corporation omnibuses have accommodation for 22 passengers, the speed being 12 miles per hour on the level and about six miles per hour on gradients of between 1 in 8 and 1 in 10. The energy consumption per mile varies with the condition of the roads, being under the best conditions about 1·3 units, while the figure runs up to about 2 units per mile when the roads are deep in thick, sticky mud. On a fine day each omnibus will run, if necessary, 50 miles on one charge. A charging station is placed at one terminus, enabling each omnibus to be given a boosting charge several times a day, which enables a fast service to be obtained during the evening without the necessity of charging during the station " peak-load " hours. Up to date the maintenance cost has been practically *nil*, and the reliability of the vehicles receives cogent attestation in the statement of the tramways manager :—" One does not have to worry about them any more than one would about an ordinary tramcar."

The omnibus which Southend Corporation Tramways Department has had in use since June 26, 1914, is similar to those employed at West Hartlepool. The experience at Southend is perhaps a little more valuable for the reason that other omnibuses of the petrol and petrol-electric type, and of the most modern make, have also been in use alongside the electric omnibus. In a report presented at the end of 1914, Mr. Birkett, the engineer and manager of the combined electric supply and tramways undertakings, dealing with the running of all three types, says :—

> " The electric omnibus is the most reliable and free from breakdowns. This is no doubt owing to the simplicity of the mechanism. The electric omnibus is so free from moving parts, there being only the motor with chain drive and differential, that stoppages due to breakdown of parts are almost negligible. It will be apparent that fewer spare omnibuses of the electric type will be needed in a large fleet as compared with petrol omnibuses. . . . Providing all necessary plant for re-tyring wheels is available, there will be no reason for possessing a stand-by electric 'bus with a fleet of six omnibuses. . . . It follows that the staff at the garage would be affected in favour of the Edison omnibus."

As to cost of operation, after eliminating from the cost ascertained up to date certain items in connection with each type of omnibus which are incidental to the inception of an omnibus service, Mr. Birkett gives the actual average cost per omnibus mile (including capital charges) for each type as follows :—

Petrol	8·56d.
Petrol-electric	8·31d.
Electric	7·52d.

Mr. Birkett further points out that in his opinion the results would be still further in favour of the electric battery omnibus if a fleet consisted entirely of the latter. The consumption of energy on the hilly route is at the rate of 1·55 units per mile, while on a route which is more or less level, the figure comes down to 1·1. The omnibus receives a short boost while waiting at one terminus, the boosting current being about 300 amperes. The average speed, including stops, is about nine miles per hour. Up to date there have been no repairs needed to the electric vehicle.

Battery omnibuses are on order for West Bromwich Corporation and for a company at Loughborough.

Ilford Council Tramways departments employ an electric tower wagon which has now been in service for over twelve months. The special advantages claimed for the electric vehicle for this work are :—

> (1) Can be started away without loss of time. (2) So simple that any workman can easily drive it, in consequence of which several men may be provided with licences insuring that whenever the call may come, a driver shall always be available. (3) More easily manœuvred against poles or under insulators and wires than a petrol or horse wagon. (4) Hand-lamps on flexibles, for night repair work, may be operated from the battery. (5) Reduced risk of fire when garaged at the tramways depot. (6) Low cost for operation and upkeep.

Although the Ilford wagon weighs some three tons, the energy consumption is only a little over a unit per mile. With the exception of the cost of a little distilled water for the battery, no expenditure has been necessary for maintenance during the time the vehicle has been in commission, and there is stated to be no sign

Ipswich Corporation's 3-ton Tip Wagon at work.

of wear upon the tires. Similar vehicles are in use by, or on order for the tramways departments at Derby and Belfast.

The Discussion.

Mr. W. W. Lackie (Glasgow) referred to the economy of electric vehicles used by Glasgow Council, and said they were also useful for testing new mains. Three years' experience of a 1-ton van had induced him to order three more, including a 1½ and 5 ton vehicles. A 1-ton van did the work of two horses and carts for £240 per annum,

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a saving of £80. The one drawback to the use of the electric vehicle —its first cost—would be rectified in time. Much remained to be done in standardising weights and dimensions, as makers who formerly confined themselves to petrol vehicles were finding it worth while to turn out electric cars.

Mr. R. A. CHATTOCK (city electrical engineer, Birmingham) had come to the conclusion that the electric vehicle was the one for commercial and industrial use. The 12-mile-an-hour speed of commercial vehicles was quite sufficient. What they wanted now was a light car on the pattern of the Ford petrol motor.

Mr. J. W. BEAUCHAMP (borough electrical engineer, West Ham)

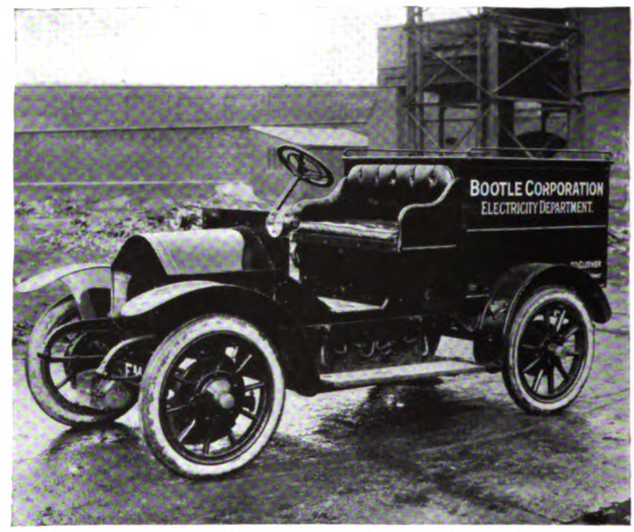
1-Ton Van of Glasgow Electric Department.

said that of the ten vehicles in use at West Ham six were repeat orders from firms who had had experience with other forms of traction.

Electric Van of St. Marylebone Electric Department.

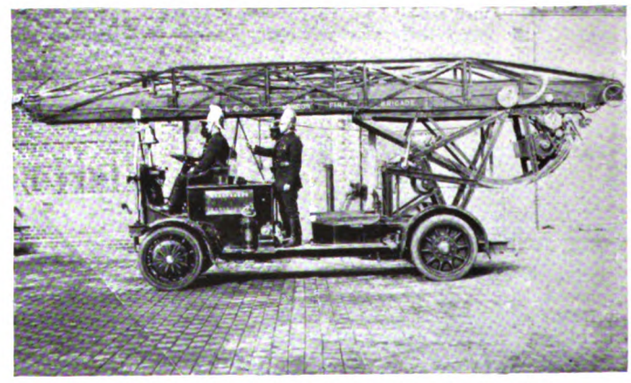
It would be best for station engineers to use a commercial vehicle for the purpose of influencing orders. It would pay best to devote attention to influencing users of heavy vehicles, who were quick to note any financial advantage. They should not confuse people by placing several types before them. The satisfaction given by the first vehicle was so great that repeat orders always followed. One hundred vehicles would consume current at 1d. per unit to the value of £8,000 per annum, which, as an off-peak load, would be highly profitable.

Mr H. S. ELLIS (borough electrical engineer, South Shields) referred to the excellent running of two Edison omnibuses by the South Shields Tramways department, on narrow and bad roads to outlying districts. They were charged between 11 p.m. and 6 a.m. in the car shed, the charge for current being ¾d. per unit. At the end of the route there was a small charging station, where the batteries were given a boost, and were able to remain in service all day, doing between 70 and 80 miles. Without the boosting they would probably have to be content with 40 to 50 miles. One disadvantage of electric vehicles generally was the first cost and also the question of speed, but they were cheaper to run and very easily handled.



Vehicle belonging to Bootle Electric Department.

Mr. J W. HAME (general manager and electrical engineer, York Corporation Tramways), alluding to the Edison omnibus in use there, said the cost of fuel per annum for a petrol omnibus would be £500 a year, as against £365 for an electric omnibus, paying 1¼d. per unit for current. The sum of £64 would pay for the coal to produce the amount of energy required for the electric omnibus. They had had no trouble with the electric vehicle. The North



Turntable Ladder Vehicle of London Fire Brigade.

Eastern Railway Company would shortly be using electric vehicles at York.

Mr. COOPER (Wimbledon borough surveyor) said that a battery vehicle which would carry tar or repairing material, together with men, would be useful for the immediate repair of pot holes, and would effect a saving of 30 per cent. over ordinary methods. An electric road roller would create a good demand.

Mr. H. WEBBER (general manager and electrical engineer, Keighley Corporation Tramways) stated that with petrol omnibuses the cost was 1s. 4½d. per mile, but a remarkable reduction was secured with the Cedes Stoll trackless trolley omnibuses. The energy cost was 0·9d. per unit per mile, as against 4½d. per mile for petrol, while there was a great reduction in the cost of tires.

Mr. J. K. BRYDGES (Eastbourne) said the Corporation had 14

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double-deck petrol omnibuses. For general service he advocated double-deck vehicles, and single-deck for feeders. Mr. Ayton's paper appeared to deal only with the latter. The cost at Eastbourne was 11d. per mile. Electric vehicles were too slow. Owing to the excessive price asked for an electric wagon and its limited load, he was unable to recommend an electric vehicle for coal cartage.

Mr. HAME added that with electric omnibuses a journey from point to point was accomplished at about the same speed that a tramcar did it in. The figure of 11d. per mile for petrol omnibuses was very satisfactory from an Eastbourne point of view, but he felt satisfied that at York with a single-deck electric omnibus they were running at considerably less cost than that sum. He thought it would be 2d. less.

Mr. J. CHRISTIE (Brighton) spoke highly of an electric vehicle used by the electricity department, and believed that traders would give orders before long. A fleet of omnibuses with Tudor batteries had given great satisfaction for a number of years to the company running them. He believed that the biggest field for development laid in the works departments, and electrical engineers should induce surveyors to organise electric services. They had just had a week's trial of a dust-collecting vehicle on every route in the town, and it negotiated the heaviest gradients. He had fitted up an old boiler-house to accommodate twelve vehicles for charging. He advocated that they should turn out the appliances to enable people to charge batteries on their own premises.

Mr. A. H. SHAW (Ilford) stated that he had ordered a 4-ton wagon to haul coal a distance of three-quarters of a mile. He would save £150 a year. A tramway tower wagon had been in use eighteen months, and had given every satisfaction. Battery tramcars had proved a success in New York.

Mr. W. H. L. WATSON (Edison Accumulators, Limited) said the difference of the petrol vehicle in speed had never been sufficient to make up for the extra cost of running. It was sometimes said that the electric vehicle was expensive in its first cost, but what they should consider was the final financial result. Users of Edison vehicles would admit that when estimates were submitted they had not been exceeded, and that in some instances a saving had been shown on the estimates. Notwithstanding the criticism both on price and speed, the railway companies were beginning to move in the purchase of electric vehicles. The Midland Company tested a road vehicle, and had given an order for twenty. In the brewery trade orders had recently been given by several large firms. A

Edison Patent Automatic Tipping Van.

vehicle had now been designed for use with dust destructors, and there were already a number of omnibuses running. In America battery tramcars reached a speed of 40 miles an hour. The economy in running recompensed for the extra first cost.

Mr. MEAKIN (Wolseley Motors, Limited) remarked that the question of speed had received too much attention, as the electric vehicle had a field of its own—short hauls and frequent stops. Except for town runabouts it was not yet satisfactory, and at speeds exceeding 12 miles the depreciation and maintenance increased. The price would have to be reduced.

Mr. WYLD (Hampstead) reported that an experiment made by his Council showed that the electric vehicle could do for 19s. 6d. what by horse haulage cost 35s. The Electricity Committee had purchased a vehicle, and let it on hire to the works department.

Mr. AYTON, replying to the discussion, said the electric vehicle was the machine for short haulage work, in which it would show results unapproached by any other type. Business could be done even at present prices, but until there was a greater demand prices would not fall very much.

PARADE OF ELECTRIC VEHICLES.

On the conclusion of the discussion, the members and delegates inspected the electric vehicles which had been assembled on the Victoria Embankment. The parade comprised a most serviceable lot of 17 conveyances of various types, the speeds of which were capable of ranging from 8–9 miles per hour by a 70-cwt. Baker

Croydon Corporation's Edison Car.

lorry to 24 miles per hour by a four-seat "Lang" coupé. Six of the exhibits were fitted with Edison batteries of 60 cells, ranging from 150 to 300 ampere hours. There were two Hart lead batteries of 44 and 52 cells respectively, five Ironclad-exide batteries of from 41 to 44 cells, one E.P.S. battery, one lead plate, one Naylor lead, and one Philadelphia lead battery. The makers or selling agencies represented were Edison's Accumulators, Limited, who showed a 40 cwt. patent automatic tipping refuse van (illustrated on this page) and a chassis of 20 or 40 cwt; Wolseley Motors, Limited, exhibitors of a 20 cwt. Baker chassis with box van body, 40 cwt. Baker chassis, and a 70-cwt. Baker lorry; the General Vehicle Company, Limited, 9-cwt. covered delivery van; and the Krieger Electric Carriage Syndicate, who exhibited a landaulette. Other firms or local authorities who contributed to the success of the parade were West Ham, Marylebone, Croydon, and Poplar Corporations, Heston and Isleworth District Council, Harrods, Limited, J. Pullar and Sons, Limited, Hertford Street Motor Company, Limited, and Heath's Garage, Birmingham. The latter showed "Millburn" and "Lang" coupés. The exhibits of the municipal bodies included delivery vans, passenger cars, and a wagon.

TRAFFIC PROBLEM IN MANCHESTER.

Three committees have presented reports on the problem of relieving congestion in the streets of Manchester, namely, the Tramways Committee, the Watch Committee, and the Improvements Committee, and the City Council recently appointed a special committee to consider all the reports and evolve a general recommendation for the consideration of the Council. The special committee has now heard the case as revised by the tramways department, and they have taken the evidence of the Chief Constable, who spoke of the matter as it appears to the Watch Committee, who are responsible for the regulations of street traffic. He spoke of the causes leading to the present congestion, and outlined the possible remedies. His evidence was illustrated by numerous diagrams shown upon the screen. The speaker emphasised the view that the trading community should be consulted and the co-operation of traders secured for any regulations proposed for the amendment of the traffic.

ACCUMULATOR OMNIBUSES FOR NEW YORK.—American exchanges allude to a project for running accumulator omnibuses in New York City in competition with other means of transport. The vehicles to be used weigh 5 tons, including the battery, carry 36 passengers, and have a maximum speed of 18 miles per hour. A motor rated at 2½ H.P. is geared to each of the four wheels. A rough estimate of cost including interest and depreciation of 10·8d. per omnibus mile has been put forward.

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MOTOR TRAFFIC.

FOUR-TON STRAKER-SQUIRE VAN.

Although motor traction has not long been introduced into the transport arrangements of some of the civil departments of the Government, the vehicles in use are of the highest character, both in appearance and in excellence and reliability of the workmanship. Notwithstanding the pressure of work still experienced by the leading makers in meeting the demand for new machines entailed by the war and by the repair of damaged chassis, H.M. Stationery Office allows no deterioration to take place in the standard of the motor vehicles employed by the department. The photograph produced on this page does justice to the handsome appearance of the latest conveyance obtained by that office, and when it is mentioned that both chassis and body were supplied by Straker-Squire (1913), Limited, of Nelson Square, London, and Twickenham, Middlesex, readers will understand that the chassis is of a type not yet excelled on the market. It is of 40 H.P., while the body accommodates a 4-ton load.

Four-ton Straker-Squire Van for the Government.

THE ROYAL AGRICULTURAL SHOW.

The seventy-sixth annual exhibition of the Royal Agricultural Society of England was held at Nottingham from June 29 to July 3, and met with an amount of support which we understand exceeded the anticipation of the promoters, and can be regarded as eminently satisfactory. In view of the national crisis through which we are passing it was not to be expected that quite the usual interest could be taken in this exhibition, either by exhibitors or visitors, and when one considers the transport and other difficulties which many of the exhibitors had to overcome in order to display their manufactures, it will be admitted that the "implement section" was most creditable, and well worthy of the attention it received. As is usual at these shows, road traction by mechanical means formed an important feature of the exhibition, but owing to the fact that the war requirements of the Government have made it impossible for a number of the leading manufacturers of motor vehicles to do anything but pay attention to their contracts, petrol exhibits were very few indeed. Only three firms who specialise in this type of vehicle were able to exhibit samples of their machines, viz., the Daimler Company, Limited, Scottish Commercial Cars, Limited, and the Star Engineering Company, Limited. J. and E. Hall, Limited, had secured space, but owing to their failure to secure permission from the war department to exhibit one of the 4-ton lorries which they are now delivering, had to abandon their project.

The Daimler Company exhibited two large oil tractors, as well as two of their standard petrol lorries, the former being the 105 H.P. six-cylinder machine capable of drawing a load of 32 tons, and the 40 H.P. four-cylinder machine, with a load capacity of 16 tons. The petrol lorries were the 2-ton and 3-ton standard machines, each being fitted with War Office bodies and painted in military grey.

The Scottish Commercial Cars Company, Limited, were showing a 1-ton "Commer Car," built at the Commercial Cars Company's works at Luton. This was fitted with a 20 H.P. four-cylinder engine, three-speed gear box, and worm drive, being an excellent example of the firm's latest B.C. type. A 3-ton "Caledon" chassis was also shown. This was fitted with a 32 H.P. four-cylinder engine (W.O. subsidy type).

The Star Engineering Company exhibited a 2½-ton machine fitted with a tank body, having been built to the order of the Anglo-American Oil Company. The chassis was a typical sample of the firm's standard machine, and exactly similar to those delivered in large numbers to the War Office.

The majority of the manufacturers of steam road vehicles were well to the fore, and a most comprehensive display of this type of machine was in evidence.

Foden's, Limited, of Sandbach, had intended to exhibit three of their world-famed machines, but so great is the demand for the vehicles they are able to deliver, in addition to meeting the demand from the War Office, that only one machine could be spared for the purpose of the show. The sample shown was one of their standard 5-ton steel-tired machines, built to the order of a Manchester carrier. This embodied the usual Foden features, with a locomotive type compound engine using steam at 230 lb. pressure, the drive being by spur gear and chain to the differential gear on the rear axle.

TARIFF FOR CHARGING ACCUMULATORS.—The tariff recommended for charging batteries of electric vehicles by the Electric Vehicle Committee is a rate not exceeding 1d. per unit at hours when the supply is available for the purpose. During certain hours in the evening when there is the greatest demand on the generating stations for the ordinary lighting consumer, the supply is not generally available for charging accumulators, although if urgently required during such times many undertakings are prepared to give it at an increased charge. The rate quoted is exclusive of housing accommodation, and in many cases it is not necessary for a vehicle to go into a garage at all for the purpose, as the charge can be given with the vehicle standing alongside the kerb.

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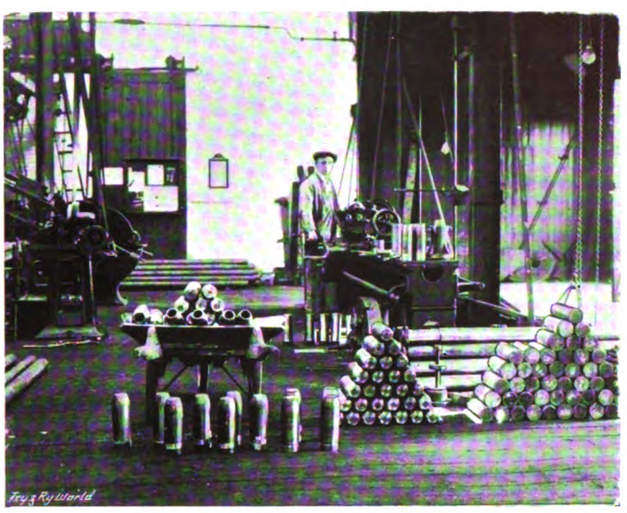
MOTOR TRAFFIC.

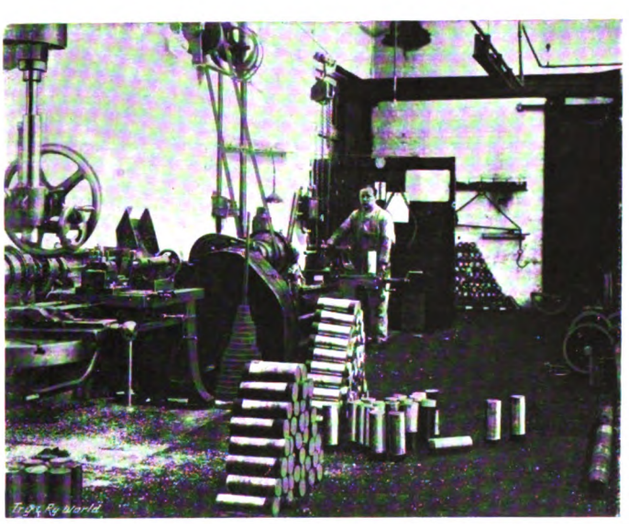
MANUFACTURE OF MUNITIONS BY SOUTH LANCASHIRE TRAMWAYS.

During the past eight or ten weeks the work of machining 18 lb. high explosive shells has been carried out in the repair shops of the South Lancashire Tramways Company, under the direction of the general manager, Mr. E. H. Edwardes, who entered into a sub-contract for the delivery of shells, and is now turning out from 150 to 200 shells per week. The number, of course, varies according to the amount of routine car repairs required from time to time.



Shells from Tramways Workshop.

The illustrations, showing the work of machining shells in progress, serve to indicate that even in small repair shops where it is necessary to have a certain number of skilled mechanics to carry out ordinary repairs, it is possible in spare time and by overtime work to do a considerable amount of useful work in the manufacture of munitions of war.



Machining High Explosive Shells.

In sending the photographs, Mr. Edwardes remarked that the particulars are not given as an advertisement, but as an illustration of how similar work may be done in many other of the smaller tramway shops as well as in the large repair shops. The illustrations will, we think, prove of interest, and we hope that they will encourage other managers to consider what can be done in their own shops in the same direction.

G.M.C. CHASSIS FOR THE BRITISH MARKET

A full range of G.M.C. chassis, with carrying capacity from 1 ton up to 6 tons, will shortly be available for the British market. These machines, which are constructed by the General Motors Company of America, one of the largest automobile building institutions in the world, are being introduced into this country by Mr. Turner-Smith, of 22, Brompton Road, London, S.E., whose experience of public service motor traction dates back to several years before the early days of the Vanguard Omnibus Company, and whose knowledge of the requirements of British traffic conditions is such as to inspire the fullest confidence. Mr. Turner-Smith has just returned from the General Motors Company's works, where he has given personal attention to the carrying out of a number of alterations, which will bring the heavier types of G.M.C. chassis thoroughly up to date in accordance with the present British practice. An important detail in this connection is the alteration of wheel and rim sizes to suit the recent decision of the Solid Tire Committee of the British Commercial Motor Manufacturers' and Users' Association.

The first arrivals in this country will be the three new models designed for loads of 1 ton and 3 tons respectively. These machines are the outcome of exhaustive experiments, the object being to evolve light high power chassis, combining the important features usually to be found only in high-priced machines, and at the same time to sell at a price that will ensure a ready sale for all classes of delivery work. The outstanding points of the 1-ton chassis are as follows: Pneumatic tires (880 × 120); 10 ft. 2 in. wheel base; automatic governed engine, sliding gear; selective type speed transmission; heavy duty springs, semi-elliptic in front and full elliptic in rear; powerful brakes acting on rear wheels, etc. The engine is the well-known "Continental," of exceptional power, the cylinders are cast *en bloc*, $3\frac{1}{2}$ in. bore with 5 in. stroke. A combination of forced feed and splash ensure a perfect system of lubrication, a strainer in the oil pan keeping the circulating oil free from dirt, etc. The cooling arrangements are on the shaft-driven centrifugal pump principle, with tubular radiator of large water capacity. The gear box, which is mounted upon an underframe, gives three speeds forward and a reverse, viz., 6–9 and 20 miles per hour forward, and $4\frac{3}{4}$ on the reverse. The final drive is by means of bevel gearing.

The two 3-ton models are fitted with British standard solid band tires, single on front wheels and twin on the rear. The engine is also made by the Continental Motor Manufacturing Company, and is of a type similar to that fitted to the smaller machine. The bore, however, is $3\frac{3}{4}$ in. with 5 in. stroke, giving 30 H.P. at 1,300 revolutions per minute. The gear box gives four speeds forward and a reverse. The final drive in the larger model is by worm and worm wheel of the Timken David Brown type, and mounted on Timken roller bearings.

At a later date we hope to give a more detailed description of the larger of the G.M.C. chassis, together with some photographic illustrations of the units. Although the General Motors Company are now supplying a large number of machines to the Governments of our various Allies, this fact does not in any way interfere with the delivery of their standard machines, as they have designed a special war model for Government purposes.

Reduced Fares to Meet Jitney Motor Competition.—The authorities of Vancouver and Victoria, B.C., not having followed the example of many municipalities in the United States in passing legislation to meet the dangerous conditions arising out of the jitney motor car competition with street railways, the British Columbia Electric Railway has introduced a new reduced fare. It is a non-transfer ticket for journeys within the city limits at the rate of 8 for 25 cents. The issue of all types of tickets previously used will be continued at the old rate to cover travel where transfers are demanded. These rates are straight 5 cent fare (strip of five tickets for 25 cents being provided for the accommodation of passengers); working-men's tickets at 10 for 40 cents, consisting of five white tickets which can only be used before 8 a.m. and five green tickets which are good at any time; and school children's tickets at 10 for 25 cents. In a circular to the public, Mr. Kidd, general manager of the company, says:—"The unfair jitney competition and the absence of even the most reasonable regulation of that extraordinary traffic, has affected the credit of the company in the London money market, and until conditions improve any further expenditure on its tramway system will be altogether out of the question."

Tipton Urban Council have been authorised to borrow £495 for the purchase of a motor fire engine.

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MOTOR TRAFFIC.

NATIONAL ROAD EXHIBITION.

Mr. Walter Long, President of the Local Government Board, on June 25 opened, at the Horticultural Hall, Westminster, the national exhibition and conference on road making, which was continued until July 1. The events were designed to take the place of the Fourth International Road Congress, which was to have been held at Norwich next year.

Mr. Long referred to the changes that had taken place in motor traffic since 1904, when he passed through Parliament legislation for dealing with ordinary and heavy motor traffic. If there was one lesson to be learned by users of the roads to-day, it was that in the special circumstances in which the nation now found itself they must be content if they did not find the roads in exactly the conditions which they had been accustomed to in recent years. A committee appointed by his predecessor was considering motor problems now, and he thought they intended to extend the scope of their inquiries. The country was only at the beginning of their experience with regard to motor traffic and how it could be adequately dealt with, and he believed it would be the duty of the Minister occupying his place, when they were in happier times, to investigate the question.

The subjects discussed were— "The use of tar, pitch, and bitumen in the construction and maintenance of roads, with special reference to the subject of corrugations"; "Heavy Traffic"; "The Classification of Roads"; and "The Reconstruction of Roads in Belgium with general reference to the injury done to roads by war operations and military traffic."

THE EXHIBITION

Reinforced Concrete for Tramways and Roads.

The exhibition comprised road material and machinery of great utility. There were over 100 stands and the exhibitors numbered 63.

Members of municipal and tramway authorities could not fail to have been interested in the application of reinforced concrete for road and tramway track construction. As laid down by the British Reinforced Concrete Engineering Company, of Manchester, or by local authorities with materials supplied, the B.R.C. roadbed fabric was introduced about four years ago, but as at that time its merits did not gain speedy recognition here, the inventor went to America. There it secured thorough appreciation, and it was not long then in making headway in this country. A striking tribute to its success is afforded by photographs taken by the company of the present condition of unreinforced and reinforced tramway tracks in Manchester, both laid in 1913. While the former is now under extensive repairs, the latter is in perfect condition. The reinforcing steel wire is made by the company at Manchester; and at Trafford Park the material has been used on light railway tracks. The road breasts on either side of tramways in a Shoreditch (London) thoroughfare and in a Salford main street have been laid in the same manner. In Ireland, Wales, and the English provinces the reinforcement has been in use for some time on portions of the Belfast and Blackpool tramways tracks, while on the Rhondda Tramways Company's lines it is now being introduced. An experiment would recently have been made on the Bournemouth tramways but for the contract for ordinary construction having been accepted. The sides of the same road, however, have been laid with the reinforced concrete, The material is laid in sheets in the concrete, transversely to the rails, transforming the concrete foundation into a unit structurally sound, so that both track and pavement are carried without settlement, and the setts maintaining an even surface with the rails.

G. F. West and Company, Caxton House, Westminster, S.W., also specialise in reinforced concrete, theirs being the lock-woven-mesh system. Their contracts have included roads and a great number of building structures, including power stations and bridges.

The Kahn system of reinforced concrete was shown by the Trussed Concrete Steel Company, Caxton House, Westminster.

The triangle-mesh method was exhibited by the United States Steel Products Company, New Broad Street, E.C. This mesh is made of solid drawn steel wire of a strength far in excess of that possessed by any hot rolled product, thereby enabling a much lighter weight of steel to be used to obtain a given strength.

Motor vehicles and appliances were staged by eight exhibitors, the most conspicuous being the Laffly street sweeping machines, nearly a dozen of them, sold to various local authorities, being on view in the street outside and one within the building on the stand of Mr. F. C. Archer, Brettenham Works, Edmonton, N.

Edison Accumulators, Limited, exhibited their well-known electric battery wagon, electric truck, and a strong platform truck, together with an exhibit showing the construction of the Edison all-steel non-acid traction accumulators. The Edison vehicles were in charge of Mr. S. G. Trehearne, whose experience in the electric traction field has been of so wide and varied a character as to render his advice of special value to intending purchasers of electric vehicles.

Lacre Motor Car Company, 78, York Road, King's Cross, had an interesting exhibit in one of their lorries which had been serving with the Expeditionary Force from October 1 until June 24. This company has made a name for its road sweeping machines, five more of which have been ordered by Glasgow Corporation.

Wichita motor lorries, two in number, were exhibited by A. F. Langdon, of the Army and Navy Garage, Greycoat Street, Westminster, S.W. These American machines comprise 1, 2, and 3½ ton models, guaranteed to be of the highest grade construction.

The General Vehicle Company's (Imperial House, Kingsway, W.C.) speciality is the electric ½ ton chassis equipped with the Warwick street watering gear, and fitted with a 44 cell, 17 plate, iron-clad battery.

J. W. Glover & Sons, Warwick, specialise in Warwick sprinklers, suitable for either motor or horse-drawn vehicles.

Hill's Motor Vacuum Road Cleanser, Limited, 4, Broad Street Place, E.C. The street cleansing machine of this company is mounted on a 45 H.P. motor chassis, and besides its sanitary advantages it effects a great saving in cleansing expenses.

Robey and Company, Limited, Lincoln, showed a 5 ton steam wagon and a compound tractor.

Nineteen exhibitors displayed road washing machinery, etc., prominent among them being A. C. Wells and Company, of Midland Road, St. Pancras, London, and Manchester. Their exhibits comprised road drying machines, the "Wells" light, acetylene lamps, portable tar boilers, waste oil filters, etc.

Road making materials were staged by 27 exhibitors. A prominent exhibit was that of Highways Construction, Limited, Finsbury Court, E.C., whose voidless asphalt macadam road has lately been given the trade name "Monolastic" for all countries. This material withstood the wet weather of last autumn and the heavy military traffic of the past ten months.

The Anglo-Mexican Petroleum Products Company, of Finsbury Court, E.C., put forward mexphalte and fluxphalte at their stall. The former is a high grade bitumen from Mexico. It gives dustless, silent and waterproof roads, which are wear-resisting under the heaviest traffic. For grouting work it is recommended as the premier material. Fluxphalte is a more liquid bitumen for road spraying. Reference has already been made to the reinforced concrete exhibits for roads and bridges, which were included in this department of the exhibition.

Fibrastic Packing for Rails.

One of the novelties of the exhibition was a fibrous packing for tramway rails, which is claimed to be the ideal material for the purpose, as it is possible with its use to give either an absolutely solid or resilient track to suit the peculiar conditions appertaining to the work in hand. The packing is made up of two principal constituents, one being a specially selected and prepared type of fibrous cable, which gives a maximum amount of resilience without any "fatigue" in the material, and the other Robbins' Non-set Plastic Cement. The latter for some years has been in universal use for all purposes where a watertight non-setting joint has been required. This packing has now had thorough and exhaustive trials, and has been found eminently suitable for packing loose joints of either single or composite pattern, and rails in any form. Where anchor bolts are in use, a layer of "Fibrastic" forms the ideal medium between rail and concrete. The material can be applied equally well in either wet or fine weather, as the cement is waterproof, and any moisture that may be under the rail is driven out in the course of applying the packing. A section of a road where the traffic is heavy and track foundations poor was treated with Fibrastic packing nine months ago, and when it was recently opened up it was found to be in the same condition as when first installed. From this result it is evident that great economy can be effected by the use of this material, as previously the engineer found it necessary to repack these rails every three of four months. Fibrastic packing has now been installed on tramways in London, Leeds, Bath, and many other systems. In every case it is claimed that complete satisfaction has been given, and further orders obtained.

Messrs. Robbins' and Company, 11, Tothill Street, Westminster, are the manufacturers and sole proprietors of Fibrastic packing and also of Robbins Non-set Plastic Cement, which has been in use by Government departments, Municipal Corporations, and railway companies for many years.

Durban Corporation (South Africa) have obtained an electric ambulance from Messrs. Carters, New Cavendish Street, London, W It has a Tudor battery.

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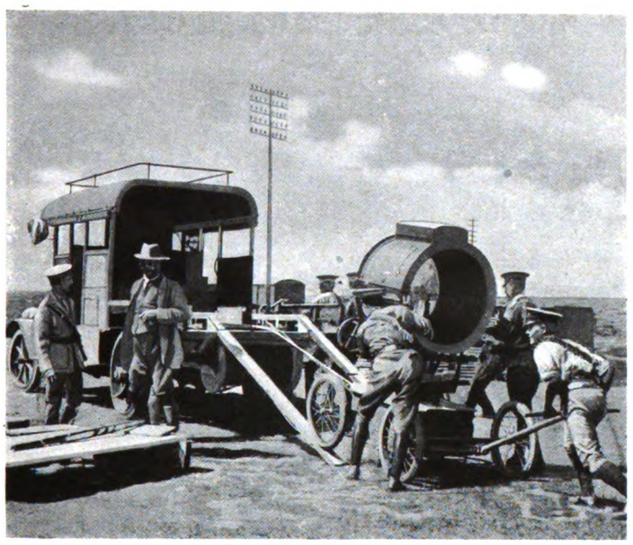
MOTOR TRAFFIC.

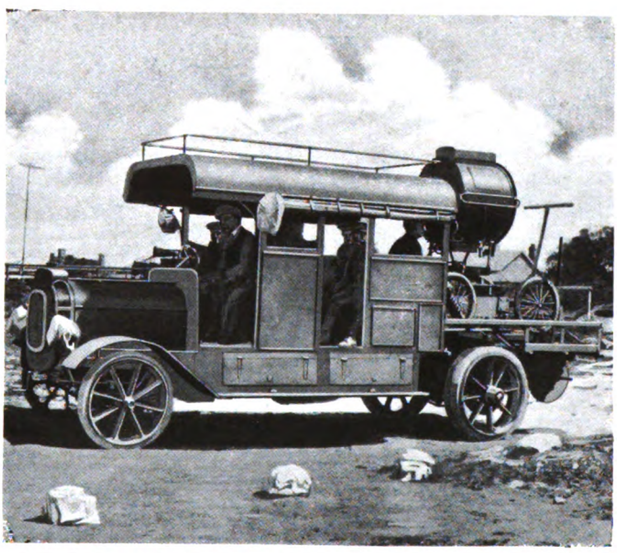
TILLING-STEVENS CHASSIS IN WAR.

Tilling-Stevens, Limited, of 26, Victoria Street, London, S.W., and Maidstone, have received the following communication from a correspondent serving with the Union of South Africa Forces operating against German South-West Africa :—" I enclose a photograph of the chassis of one of your cars, of which two have been fitted up by the South African Railways in Pretoria for use in German South-West Africa.

" The car is fitted for signalling purposes, and works splendidly to a range of 50 miles on a cloudy night. The lamp is fitted up on heavy motor cycle wheels, and we have a drum under the rear of the car which contains 110 yards of double cable, so we can dismount and run the lamp out that distance. There is a throw-over switch and circuit-breaker inside the car, one throw for the lamp the other for running. The volt and ampere meter are on the dashboard. We work the engine until we get 80 volts and 100 amperes, and after it is set we have no trouble with the engine or generator. The motor runs very smoothly.

" The country is a good test for such a heavy car. We were told that it would be impossible to get through, as no heavy lorries would undertake it. Although we are twice the weight of the motor lorries we got through, and are proud of it, as in places the sand was a foot deep. There are seven men to each car. A large petrol tank is under the front seat, which holds four cases, and a water tank is fixed on the side of the car, holding 30 gallons. Under the back seat are lockers for five extra cases of petrol. We can undertake any repair work in the field."





Tilling-Stevens Chassis Equipped for Searchlight Work.

MANCHESTER CORPORATION OMNIBUS COSTS.

In August, 1914, the War Office impressed six of the omnibuses of the Manchester Corporation. Since that date the committee has hired several vehicles, but more recently the service has had to be curtailed. A summary of the expenses per omnibus-mile for a the year ended March 31 last is appended :—

	Per 'bus mile. d.
TRAFFIC EXPENSES—	
Superintendence and traffic wages	·220
Wages of drivers and guards	2·289
Bonuses and sick pay	·062
Cleaning and oiling	·313
Depot expenses	·142
Ticket check	·177
Uniforms	·099
Licences and sundries	·087—3·389
GENERAL EXPENSES—	
Salaries and wages—Administration	·156
Rates on depots	·072
Printing and stationery	·022
Fuel, light, and water	·014
Compensation	·110
Insurance	·014—0·388
REPAIRS AND MAINTENANCE—	
Tires for own vehicles	·658
Chassis	·685
Bodies	·115
Buildings and machinery	·059—1·517
Hire of chassis	·297
Power expenses—petrol	1·776—7·367
Depreciation	·703
TOTAL EXPENSES	8·070

Total receipts were £6,192, or 9·244d. per omnibus-mile, thus leaving a balance of 1·174d.

The number of omnibus-miles run was 160,775, and the passengers carried was 1,186,569.

MOTOR VEHICLES FOR MUNICIPALITIES.

EPSOM COUNCIL propose to purchase a motor fire engine at £1,000.

HULL COUNCIL is recommended by the Fire Brigade Committee to purchase a motor fire engine.

TWICKENHAM COUNCIL have taken delivery of a Dennis motor fire engine, purchased for £1,125.

SOUTHAMPTON COUNCIL have been authorised to borrow £1,085 for the purchase of a motor fire engine.

LEWISHAM GUARDIANS have deputed a committee to consider the purchase of a motor ambulance.

MARYLEBONE COUNCIL have agreed to purchase two Laffly motor road sweepers at £650 each.

BOURNEMOUTH COUNCIL have placed an order with Messrs. Aveling and Porter for a steam tractor at £450.

LUTON COUNCIL have a scheme under consideration whereby the entire work of refuse collection will be done by motor vehicles.

NOTTINGHAM HIGHWAYS COMMITTEE hope shortly to add to the number of mechanical vehicles now in the service of the Corporation.

CARDIFF CORPORATION have received the sanction of the Local Government Board to borrow £1,100 for the purchase of a petrol motor fire engine.

MANCHESTER CORPORATION have sanctioned the purchasing by the Watch Committee of a motor prison van and three ambulances to replace horse-drawn vehicles.

EDINBURGH COUNCIL have adopted a recommendation for the purchase of a motor fire engine at an estimated cost of £1,130. The Council recently took delivery of two such machines.

HASTINGS CORPORATION have applied to the Local Government Board for sanction to borrow £633 for the purchase of a 5-ton tractor and a 3-ton trailer. This step has been taken in consequence of the difficulty of obtaining draught horses.

OLDHAM TRAMWAYS COMMITTEE on June 17 considered a suggestion made by the general manager for the purchase of a motor van at £260 in order to facilitate the delivery of parcels in the outer district. The opinion was expressed that a cheaper van would serve the purpose, and the manager was asked to submit a scheme at the next fortnightly meeting.

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MOTOR TRAFFIC.

MOTOR TRAFFIC NOTES.

THE PORTUGUESE GOVERNMENT has purchased a number of 30-45 cwt. motor chassis from the Napier Company, London.

MUD SPLASHING BY OMNIBUSES.—Crewe Corporation is pressing the managers of the motor omnibuses running through the town to provide their vehicles with adequate mudguards.

CONVEYANCE OF WOUNDED SOLDIERS.—Birmingham Council has agreed to purchase an additional motor ambulance at a cost of £630 for the conveyance of wounded soldiers coming into the city.

NINE THOUSAND POUNDS FOR OMNIBUSES.—Under a Parliamentary Bill passed on June 17, Rotherham Corporation obtained power to purchase additional motor omnibuses at an estimated cost of £9,000.

A NEW SERVICE AT BRIGHTON.—The local omnibus company has applied to the Corporation for sanction to run a service of single-deck vehicles between Seven Dials and the Montpelier district down to the sea front.

MOTOR WATER VAN AT SOUTHPORT.—A motor watering van has been experimented with at Southport, with the result that the highways surveyor reports that it has accomplished as much work as could be done with five or six horse water-carts.

SPEED OF A MOTOR OMNIBUS.—In a prosecution at Aberavon of a driver for driving a motor omnibus in a reckless manner, the defendant admitted, in reply to the police superintendent, that his vehicle was capable of a speed of 30 miles an hour.

MOTOR TRANSPORT IN SOUTH WALES.—The South Wales Transport Company has extended its omnibus services to Burry Port. A request has been laid before the Great Western Railway Company for the augmentation of that company's road motor service in consequence of the vehicles being overcrowded.

EFFECT OF A COLLISION ON SEAT FASTENINGS.—Twenty-seven persons were injured in a recent motor omnibus accident at Chester-le-Street, county Durham. The vehicle got out of hand, and crashed through a billposting station and a brick wall behind it. Every seat was torn from its fastenings, and the passengers were thrown violently to the front end.

NEW OMNIBUS CHASSIS FOR OXFORD.—The Austin Motor Company, Birmingham, recently delivered six chassis to the Oxford Tramways Company. Upon these the company has mounted the bodies from the Daimler chassis which were impressed by the War Office. The vehicles have proved satisfactory in their running, and are the means of improving services to several districts.

LONDON OMNIBUSES.—The number of omnibuses licensed in London is gradually being increased by the efforts of the works department of the General Omnibus Company. The additions turned out to take the place of vehicles impressed by the War Office number about 30 a month. There are now about 2,230 vehicles, as compared with 3,420 at this period last year.

MOTOR FIRE ENGINES TO BRING JACKS FOR TRAMCARS.—Now that Salford has been equipped with the Gamewell fire alarm, the crews of the tramcars have been instructed, as an experiment, to ring up a fire station whenever a jack is required for lifting a car. The new motor fire engines will accommodate a sufficient number of jacks to raise a tramcar off the rails within three minutes.

AVON TIRES FOR PLATFORM TROLLEYS.—The smallest solid rubber band tire ever made is said to be one for which the Avon India Rubber Company, Limited, Melksham, Wilts., has recently received an order from the Great Western Railway. Its outside diameter is 15½ in., and it is intended for use upon the electric platform trolleys now so common a feature at all large terminii.

INSTRUCTION FOR FORD MILITARY MOTOR DRIVERS.—Facilities are offered at the Ford motor car factory at Manchester to men desirous of undergoing a probationary training with a view to joining the A.S.C. Mechanical Transport. Large numbers of enlisted men have for some months been attending the factory in order to familiarise themselves with the care and driving of Ford vehicles. Up till the end of May, 247 of the company's employees had joined the Forces.

OMNIBUS FOR RANGOON.—The announcement was made at the annual meeting of Rangoon Electric Tramways and Supply Company on June 23 that during the year the experimental motor omnibus service had been maintained. The type of motor omnibus to meet the views of the Municipal Committee and the public of Rangoon had been a very difficult problem, and had not yet been finally determined. The Municipal Committee object to heavy vehicles on the roads.

BRITISH MOTOR VEHICLES IN INDIA.—During the year ended March 31, 1914, India imported motor wagons to the value of £38,049. Of that total the United Kingdom supplied vehicles of the value of £23,694, and the United States £4,382. Reports published in the Indian newspapers of late indicate that the motor car trade in India is threatened with a scarcity amounting almost to a famine of English cars. This is due to the conditions imposed upon manufacturers by war work. American cars are finding a ready sale.

PROPOSED TAX ON HEAVY MOTORS IN VICTORIA.—Following the example of the Middlesex County Council in England in obtaining powers from Parliament to impose a car-mile tax on heavy motors using the Great West Road, which the Council is constructing, the Councils of Melbourne and other municipalities have requested the Victorian Parliament to impose a tax of three-eighths of a penny per mile on the owners of omnibuses and other heavy motors. It is proposed to tax only vehicles with solid tires, and the mileage is to be calculated on the amount of petrol consumed.

OMNIBUS OPERATION AT YORK.—Mention was made at a meeting of York Corporation on June 7 by Alderman Meyer, chairman of the Electricity and Tramways Committee, that the receipts per omnibus mile of the electric omnibuses of 7·05d. for the month of April would not cover expenses. It was unreasonable to expect that at their inception the omnibuses would earn sufficient to meet the expenses. The Stockton Lane to Nessgate route earned 8·08d., and the Heworth Church to Clifton route earned 6·61d. The motor omnibuses were doing much better than was expected at the beginning. Taking into account the way in which they would feed the tramways, they were a sound undertaking.

MOTOR OMNIBUSES ON MACADAM ROADS.—Councillor Cadbury, jun., at a meeting of Birmingham Corporation on June 1, complained that the cost of running motor omnibuses was 50 per cent. more than the tramways. There was also the increased expense of road maintenance to be considered. Councillor Barrow, chairman of the Tramways Committee, agreed generally with what had been said about the cost of running the omnibuses, but pointed out that those on the Harborne route had only been running during the winter so far as the Council was concerned. It was anticipated that the cost of running during the summer would be less. It had been proved that omnibuses were not suited for macadam roads.

NATIONAL MOTOR AND CYCLE VOLUNTEER FORCE.—Sir John Courtis, chairman of Cardiff Tramways Committee, convened a meeting of motorists which was held on July 11 at the City Hall, Cardiff, for the purpose of discussing a suggestion for the formation of a volunteer motor corps. Sir John said the idea was to form a mobile force which, in case of an attempted invasion, could be of assistance to the military authorities. The suggestion was that the corps should form part of the National Motor and Cycle Volunteer Force, which was affiliated to the Central Association of Volunteer Training Corps, and was commanded by Major-General D. C. F. Macintyre, C.B. A company would consist of 80 cars and 160 men, and it was suggested that a battalion might be formed for Glamorgan. Lord Kitchener was very much in favour of the movement.

NEED FOR OMNIBUSES IN SOUTHAMPTON.—Mr. W. T. Robson, who, as tramways manager and electrical engineer at South Shields, introduced electric omnibuses as a feeder from an outlying district, has already announced that motor omnibuses are required in Southampton, where he is now general manager. Mr. Robson, in July last, was the second tramways manager to introduce Edison omnibuses in this country. They have, he states, been running very satisfactorily, and at the lowest comparative cost of any of the municipal omnibus services. In addition to being invaluable as feeders to a tramway system, omnibuses, Mr. Robson says, serve a very useful purpose for testing a route with the object of finding out whether it was capable of providing a paying traffic for tramways. If the omnibuses stood the test, a tramways scheme could be proceeded with.

SPLASHGUARD EXPERIMENTS ON MOTOR OMNIBUSES.—Experiments have been carried out on some of the Oxford motor omnibuses by the Oxford Electric Tramway Company, in the hope that before next winter some effective means may be found to prevent mud-splashing. The latest model is a disc fixed to the wheels, extending almost to the ground, and revolving, of course, with the wheels. In such little muddy weather as Oxford has experienced since the trials were begun, the contrivance has worked successfully, but the trials will be prolonged for a time to test its mechanical strength on the Oxford roads. The *Oxford Chronicle* states, however, that those in use have survived frequent journeys on Cowley and Banbury Roads. Former experiments have, it is stated, all been satisfactory as regards the prevention of mud-splashing, but in each case it was found that the devices were not sufficiently sound mechanically to stand the wear and tear of the local roads.

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THE Tramway & Railway World
WITH MOTOR TRAFFIC SECTION

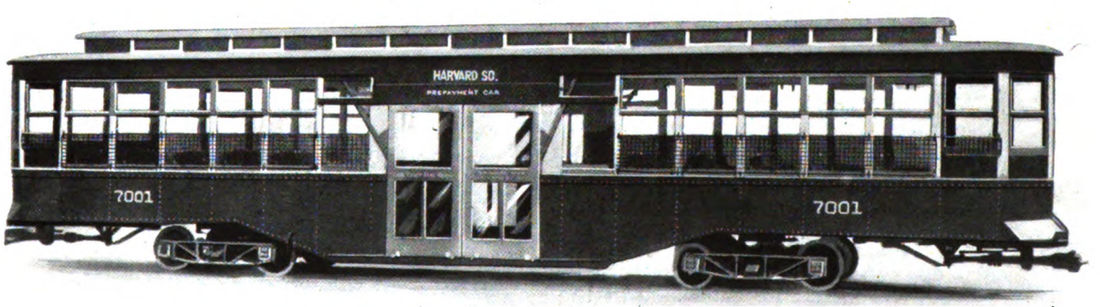
Founded 1892. LONDON, AUGUST 12, 1915. VOL. XXXVIII.

NOVEL DESIGN FOR TRAILER CARS.

AN EFFORT TO SOLVE THE "RUSH-HOUR" PROBLEM.

American tramway managers are indefatigable in their efforts to discover types of cars which are specially adapted to service on crowded routes in large cities. The problem presents many difficulties, and notwithstanding the time and painstaking study which have been devoted to the subject for many years, there is probably no tramway manager either in America or this country who would be willing to say that the ideal car body has yet been found. Owing to the conditions which hamper tramway enterprise in this country, arising mainly from the exceedingly low fares at which our undertakings have to be worked, and, to a lesser degree perhaps, to the factor of municipal ownership, our experiments with car bodies have been comparatively few. With the exception of the introduction of covers for the upper decks of cars, and the front entrance innovation adopted in a few instances, no striking alteration has been made in the design of tramway cars since the introduction of electric traction; and this is also true of the Continent of Europe. In America, however, mainly owing to the higher fares which leave a more ample margin for maintenance, and what is known on American railways as "betterment," tramway owners are able to devote more attention and more money to experiments designed to improve the facilities offered to the public and the ultimate financial conditions of the undertaking. Sums are spent in this direction which would astound some of our tramway committees. Where it is possible to experiment in this way there is no doubt that tramway users, as well as owners, must be greatly benefited; and it is much to be wished that our tramway committees would adopt a more liberal policy in this respect, and allow their officials a freer hand in efforts to improve tramway methods.

The innovation, or, more strictly, the reversion to, the use of trailer cars is one of the directions in which new ideas would be specially useful in this country. Among American companies which use trail cars the Boston Elevated Railway Company, which has a large mileage of tramways, has been confronted with the problem of relieving "rush-hour" traffic, which presses as hardly upon them as it does upon the London County Council and some of our larger municipal undertakings. In the effort to solve the problem they recently ordered from the J. G. Brill Company 75 trail cars, which they propose to run from 7 to 9 in the morning and from 4 to 6.30 in the evening on certain routes where traffic is particularly heavy during those hours. They wished to provide a single deck trailer car with a seating capacity of 62 and with wide and low centre entrances. The first of these cars has now been delivered, and it is shown in the accompanying illustrations. To secure the features desired it was necessary to design the underframe of the car in such a way as to reduce the weight as much as possible. The sides were made in girder form, and arranged so as to carry the entire load. By spacing the bolsters apart half the length of the car, the weight of each half is balanced on its truck, thereby reducing the strain at the centre entrance and avoiding a heavy construction around the centre doors. The side plates are of 3-32 in. thickness, and riveted to continuous angle sills, which are depressed 18 in. to provide for the low centre platform. At the top of the plates is a reinforcement of a bar 3 in. by ½ in., and light angles which serve as seat supports, and add stiffness. T-posts are riveted to the plates and spaced at 2 ft. 6 in. centres. By placing the wide leg of the angle sills horizontally, ample surface is afforded for a secure connection of the crossings without the use of gusset plates. The crossings are composed of pressed steel



Trailer Car with Low Side Entrance and External Doors.

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channels 5 in. deep at the centre. Diagonal braces of 2½ in. steel plate aid in preserving the squareness of the structure. The riser at each side of the centre platform is a pressed steel Z-shaped member. A 3-16 in. plate, 22½ in. wide, extends over the end sill,

Trailer Car with Centre Doors Open.

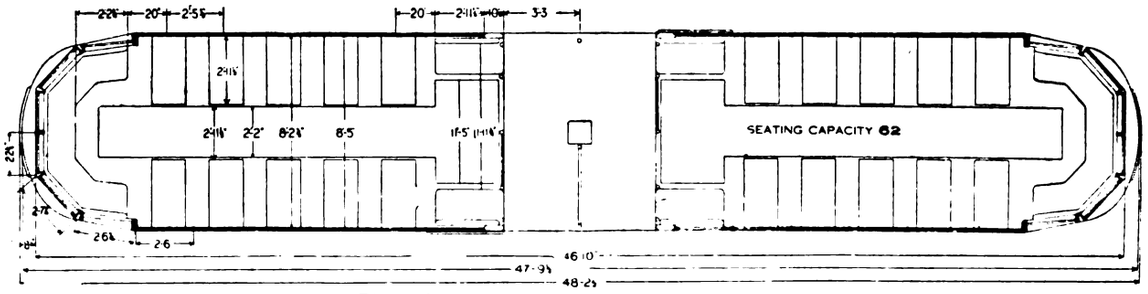
and other members, to which it is riveted, and is intended to provide resistance to buckling in case of collision. The bolsters are formed of two pressed steel diaphragms riveted to 11 in. wide top and bottom plates. In the upper structure the posts incline inwardly 4 in. on each side, to secure clearance in subways, and are connected with an angle iron which serves as the top plate. A furring strip is attached to this and the roof carlines are mortised into it. The roof is of wood, supported at each side of the centre platform by pipe stanchions and at the ends by headers. There is a light steel truss between the stanchions and headers.

The floor is of single thickness between seats and double thickness in the aisle, being wide enough to include the seat pedestals; the top floor in the aisle and in the centre platform is composed of grooved maple. From the thresholds of the centre platform the floor is ramped 1¾ in. to the centre, and from the riser at each side there is a ramp of 4 in. for a distance of 4 ft. 9 in. As the floor at each end is 27⅞ in. above the track the ramps give a height from track to threshold of 14½ in. and height of riser 9⅝ in.

The interesting door arrangement consists of double sliding doors hung outside the car, and conforming to the inclined shape of the sides. They are hung from an overhead track, and have guides and rollers at the bottom. The upper part of the door is glazed with plain glass, and the lower with clear wire glass. Compensation for the light structure of the doors is obtained by the use of concealed reinforcing rods, three to each door, and extending from top to bottom. The doors are operated pneumatically by an engine placed overhead, just below the side sign, and the operating handles are in a specially designed standard located in the centre of the platform, whence a removable railing extends to a centre pipe stanchion in the doorway at each side.

At either side of the door is a stationary sash, beyond which five windows have the upper sashes framed together in one section. The top of this continuous sash panel is held in position by a lip formed in the lower edge of the pressed steel letter board; at the lower edge the sash panel is held by malleable iron holders bolted to the T-posts in a manner to permit removal. The lower sashes are arranged to raise their full height, and the window openings are protected by 17⅝ in. wide wire screens having 2 in. wire mesh and pipe frames. The five windows at each end of the car have single sashes arranged to drop into covered pockets, and are provided with adjusting racks to permit their being held open in three positions.

The interior finish is of straight grained mahogany, and the rafters and inside of the monitor roof are painted white. The side roofs have an agasote headlining also painted white. There are ten cross seats and two stationary longitudinal seats on each side, and a semi-circular seat at each end. Hand strap rails with hand straps extend from the platform to the end of the car at each side. Push buttons are provided on each side post. At the side of the platform on the centre line of the car is a pipe stanchion which, in addition to serving as a grab handle, is used for a brake staff and operated by a drop handle. In the recess in the riser is the brake ratchet and pawl with sufficient space to allow the conductor to release the pawl with his foot.



Plan of Trailer Car with Centre Entrance.

Interior of Trailer Car with Centre Entrance.

Brill 53-F diamond truss frame trucks are employed for all the cars, and they have 24 in. diameter wheels and 5 ft. wheel base.

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THE EVOLUTION OF TRACTION MOTOR GEARING.*

By W. G. Carey.

The design of the gear equipment of the first small electric railway motors was adapted from established practice in the construction of gear trains in stationary apparatus. Abundant space was available for adequate cast-iron gears. With increase in size of motors it became convenient to substitute cast steel for cast iron in order to secure increased strength while conserving interchangeability on existing trucks; and thereafter for many years cast-steel gears with machine-steel pinions continued to be used in universal practice. The speed reductions from the armature shaft to the axle ranged from about 3 to 1 to 4·78 to 1, and pinions and gears wore out in about these ratios. The obvious advantage of increasing the life of the pinion to approximately that of the gear, in order to improve average conditions of mesh and to reduce the cost of frequent renewal of pinions, led to early experiments in case-hardening of pinions. In applying this process, practice satisfactory in other arts was followed and little attempt was made to modify, for the special conditions, the process as usually carried out. The first case-hardened pinions exhibited consequently a considerable measure of warping from the heat treatment, which fact involved high cost in rejections in manufacture. Also, this warping and other results of the treatment caused in many cases destructive wear of the companion gear, and the net results were such that no really great interest in any form of heat treatment of gearing was felt until increased size of motors, for which an active demand was arising, made imperative an increase in the strength of materials. The pitch of teeth and width of gear face had been increased to the limit allowed by available space on the trucks, and the strongest cast steel practicable for machine operations was found inadequate; therefore, to meet the severest conditions resort was had to alloy steels with partial success in keeping equipments in service. Experiment to determine the alloy steels best suited for the purpose required, however, a long time and involved heavy expense, and heat-treated carbon steels tried out at the same time afforded excellent results. Painstaking study by manufacturers of railway apparatus, aided by the broad-minded co-operation of operating engineers, soon resulted in the determination of suitable material and the development of methods in heat treatment adequate for the severest conditions in present normal practice.

Incidentally, the modification of the material and its heat treatment, together with increased strength, produced considerably increased hardness, and, at least for city service where the strength of untreated gears was still adequate, the old idea of a pinion harder than the gear, tending to equalise the life of the two, was in a measure realised, and within a very short time the untreated pinion was entirely discarded, even for service in which the strength of the heat-treated steels was entirely unnecessary.

Only experiment could determine certainly the effect of the hard pinion on the untreated cast gear, and some curious results developed in special cases. In one of the first installations on a considerable scale the hardened pinions wore out completely in about half the life of the old untreated machine-steel pinions, and this proved to be due to the presence in the gear grease of considerable quantities of very hard sand prevalent in the neighbourhood, which, getting into the gear case, became embedded in the surface of the soft gear teeth, forming a lap for the rapid destruction of the pinion teeth. On the whole, however, with good methods of lubrication and maintenance of equipment, heat-treated pinions having a hardness not exceeding approximately 300 in the Brinnell scale appear to afford greatly increased life without measurable reduction in the life of an untreated companion gear.

Continued experiment in case-hardening developed means of avoiding most, if not all, of the original trouble of warping in treatment, and the process was applied experimentally on a considerable scale to the cast gears as well as to pinions; and increased life, altogether out of proportion to the increased cost, was immediately obtained. Split gear castings, however, still gave some trouble from warping on account of their irregular sections. At that time split gears were in considerable demand, although the use of solid gears had already commended itself strongly for many reasons. Split gear bolts had always given trouble and it was easier to obtain sound castings in the more regular sections in the solid gear, and these considerations had begun to have a considerable influence in hastening the provision, in repair shops and inspection barns, of wheel presses and other facilities for handling solid gear equipments. In the present state of the art of case-hardening pieces of such size and shape as motor gears, this matter of warping is not so serious a matter, as its control has been greatly improved; but at that time a general readiness to substitute solid gears greatly facilitated the trial of case-hardened gearing on an extensive scale in service.

This material is essentially a low-carbon steel with the surface impregnated with additional carbon and heat-treated. The usual practice is to shroud portions not required to be hardened so that only the tooth surfaces are exposed to the "cementing" process, as the incorporation of additional carbon is called. Therefore, only the carburised portion hardens in quenching. It is usual practice to carry the depth of impregnation of carbon in the tooth surface to about the limit of allowable wear, which, in three-pitch gearing, is approximately $\frac{1}{16}$ in. This, however, is subject to very definite control and is varied within limits for various conditions.

The surface of case-hardened gear and pinion teeth shows hardness about 95 in the scale of the Shore schleroscope. It is not practicable to measure this material with the Brinnell instrument for the reason that the uncemented core will not stand up under the pressure necessary to effect an indentation, and such pressure also causes deformation of the pressure ball. The schleroscope is also to some extent misleading, as different conditions, such as size of parts tested or method of their support in test, give rise to considerable inaccuracies. In experienced hands the most reliable comparison of hardness of specimens of materials of this class is a file test, though this may be entirely misleading in comparison of different alloy steels. Modern case-hardened carbon steel which gives a schleroscope reading of 95 can just be scratched with a very fine Swiss file.

This class of gearing, because of the price at which it could be marketed was manifestly a great improvement in economy of operation, wherever it might be sufficiently strong to withstand the shocks of service. No test, other than that of service, has been devised for determining its resistance to service stresses, but that the limit of its strength is below the requirements of the heaviest modern service appeared probable and has since been demonstrated. In the first days of its use much virtue was attributed to the toughness of the low-carbon core, but this toughness cannot manifest itself under stresses on the whole tooth, and a tooth strained beyond its strength breaks short. It is evident

* From *The General Electric Review*, New York.

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that substantially the entire tooth strength must be found in the hardened case, and the factor of safety, even with the enormous elastic limit of this high-carbon case, promised to be too low for safety in the heaviest equipments throughout the very long period of its probable service. Although this gearing has been used very conservatively on motors of over 125 H.P., and then only in the light of careful study of operating conditions, the original estimates of strength have been closely borne out. Breakage has occurred in certain carefully watched test equipments after two years of service where wear had hardly begun. This has in some cases undoubtedly been due to fatigue of the case from repeated shocks closely approaching the elastic limit, and in other cases to subsidence of the soft tooth core resulting in cracking of the case.

It is therefore known to-day that, while with motors of less than about 100 H.P. this type of gearing is sufficiently strong to resist fatigue until worn out in service, its application with heavier equipments can only be advised in the light of a very definite understanding of the conditions of operation. With such heavier equipments, especially in high-speed service with rapid acceleration and liability to abnormal shocks such as are produced by commutator flash-overs or line breaks at the collector, the case-hardened gearing appeared and has already been proved to have an inadequate factor of safety.

Attention was then turned to a modification of the homogeneous heat-treated gearing with a view to increasing its hardness to attain increased life and a greater elastic limit, which was essential in order to defer fatigue beyond the extended limit of wear. The physical characteristics of heat-treated steels depend upon a considerable number of variable factors in the constitution of the steel, the manner in which it is worked, and methods of treatment. The constitution of the material can only be definitely controlled within certain limits which are well recognised in steel manufacture, and variations in the constitution affect final physical characteristics, though the variations may be corrected in a measure by corresponding variations in treatment. Such methods, if carried to too great a refinement, are prohibitively expensive, and the development of the desired new type of gearing involved a method of analysis and an adjustment of treatment which would be commercially practicable.

The type of heat-treated gearing which had become recognised as a heavy-service standard showed elastic limit varying in regular production from 80,000 to

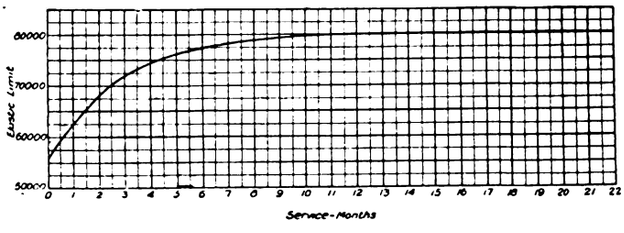

Fig. 1.—Showing Relation between Elastic Limit and Time for Fatigue.

90,000 lb. per square inch, although occasionally specimens showed still higher values, and certain other specimens with elastic limit varying down to 70,000 lb. per square inch were put into service in the earlier days of this development. Throughout several years a record was kept of mileage and physical characteristics of all specimens broken in a service of known character, and the curve in Fig. 1 shows relation between elastic limit of broken specimens and the time required for fatigue to the breaking point in normal service.

This shows that maximum stresses on the gear teeth, which could be determined in no other way, are equivalent to about 70,000 lb. per square inch in the teeth, since all specimens broken early in service show approximately this value. Higher values are shown to afford longer life, until the specimens broken toward the limit of wear invariably show an elastic limit of approximately 80,000 lb. per square inch, and in no cases have specimens showing higher values broken in service.

With a lower ductility, it was assumed—and it is in all probability true—that a larger factor of safety would be necessary to defer fatigue beyond the limit of wear, and a composition was selected and methods of working and treatment determined which would give an elastic limit of 140,000 to 150,000 lb. This steel shows a hardness approximately 500 in the Brinnell scale, and, while no very definite comparison with hardness of case-hardened gearing is possible, such rough comparison of the Brinnell and schleroscope scales as is possible and the file test indicate the hardness to be approximately 85 per cent. of that of case-hardened gearing.

Commercial application of this type of gearing has been made with the greatest care, and it has not yet been trusted in the heaviest service, although since its first commercial use two years ago about 7,000 equipments of this gearing have been installed with motors of all power up to 150 H.P., and there is no record of breakage of a single tooth within the limit of wear.

It has been pointed out that various factors had contributed to a marked tendency to substitute solid for split gears. This tendency was manifest in all classes of service, and its wide spread made possible the realisation of an old idea of using forged blanks in place of castings for axle gears.

The manifest advantage of forgings in entirely eliminating shrink strains and other faults not altogether avoidable in castings was important, but not all of the desired end. It was practicable to machine steel of a higher carbon content, and the strength and toughness could be greatly enhanced by the operation of forging the blank. The very great diversity of combinations of shape and dimension required involved an enormously expensive development cost, and it is probable that this would have long deferred the general substitution of forged for cast solid gears, were it not for the fact that the development of the homogeneous heat-treated types absolutely required forgings, since the desired physical characteristics were unattainable in castings. The cost of manufacture is so far a little higher, but this would probably be justified by the certain and invariable integrity of the blank, even with the same life factor. In addition, however, the untreated forged gear shows approximately 20 per cent. higher elastic limit, and nearly 25 per cent. greater hardness, and these characteristics afford an increased life approximately proportional.

There are then available in the art to-day three modern types of gearing, each of which may have its appropriate field, although there may be some difference of opinion as to where and to what extent these fields overlap. The first essential in the selection of a type is adequate strength for positive assurance against breakage within the limit of wear.

There are thousands of motors in operation which are destined to be superseded by more modern machines within the expected life of heat-treated gearing, and in such cases no advantage can be gained by the use, at higher cost, of a type which cannot be worn out within the life of the apparatus; and, therefore, the untreated forging is clearly the only type to be considered.

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Also, many important systems have been completely equipped with case-hardened gearing, and the problem of changing over to another type, unless the two types can be successfully operated together, is a difficult one, and such a change must be effected gradually. Both of these considerations must be taken into account,

Fig. 2.

although in the end practice will be standardised on the basis, first, of safety, and then of annual cost of maintenance.

In the meantime, in substituting complete gear equipments of the modern heat-treated steels for untreated gears with heat-treated pinions having hardness of about 250 to 300 in the Brinnell scale, it is evident that some trouble will be involved in attempting to maintain the proper combinations, and the result of combining gears and pinions of widely differing hardness under all service conditions is very uncertain. While occasional instances of successful operation of even case-hardened pinions with untreated gears are reported, it is certain that such combinations will

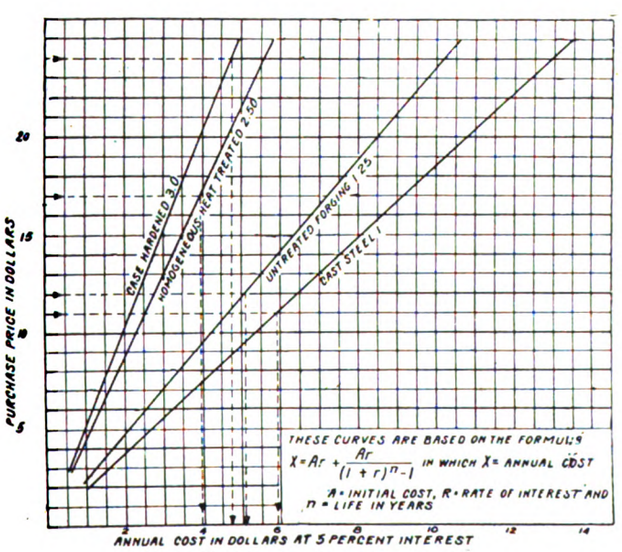

Fig. 3.

generally result in reduced life of the softer member, and in effecting changes in their practice most operators are taking the trouble to provide pinions of only moderate hardness for use with their untreated gears and meshing all new gears of more modern types with pinions of the same types.

For the purpose of estimate of maintenance cost, life factors of different types must be assumed, and the following are based upon records of service under widely varying conditions :

Grade.	Life Factor.
Untreated cast steel	1
Untreated forged steel	1·25
Homogeneous heat-treated	2·25
Case-hardened	3

These estimated life factors, with cast steel taken as 1, are about proportional to the relative hardness of the respective types, which factor should, and apparently does, reflect fairly closely the average life in service. Based upon these factors and an assumption of 5 per cent. interest on investment, the curves in Fig. 3 show a comparison of the respective maintenance costs of the four types here considered, at the prevailing market prices of a representative gear for city service.

It has been said that the heat-treated carbon steels now available have proved adequate for the severest conditions in present normal practice. It is known, however, that we are already near the limit of strength of this material, and the added demands of apparatus already projected, and of at least one existing application of somewhat special character, call for an additional factor of safety to maintain strength requisite for service to the limit of wear. Experiment on an extensive scale is being conducted with various alloy steels and various treatments, and encouraging results are promised, particularly with chrome-vanadium. Owing to its narrower base, the strength of the pinion tooth is measurably lower than that of the teeth of its companion gear, and there will undoubtedly be a wide range of applications in which alloy steel pinions may be used with carbon steel gears, and by virtue of an elastic limit of something like 170,000 lb. per square inch, which appears attainable, will equalise the difference and take us another long step in the development of this art in which we are so circumscribed by the fixed dimensions of the trucks.

MANUAL OF ELECTRICAL UNDERTAKINGS.

Eighteen hundred and twenty-two pages, exclusive of advertisements, constitute the 1915-16 issue of the *Manual of Electrical Undertakings and Directory of Officials*. As usual, the volume has been compiled under the direction of Mr. Emile Garcke, M.I.E.C., F.S.S., and this is the nineteenth annual issue. The price is 21s. net, a moderate sum when the reader comes to look at the wide range of the contents and the completeness of the information. The first volume, published in 1896, contained particulars of 200 electrical undertakings ; the present edition gives statistical and general information (including names of about 20,000 officials) relating to about 3,000 electrical undertakings. Fifty new maps are given of the electric railway and chief tramway systems, and a separate map in a case shows the electric light, power, and traction undertakings in the United Kingdom. Electric railway developments are dealt with by descriptions of the work completed or in hand, and also by maps. The completeness of this section may be estimated when we mention that a map is given of the very extensive suburban railway system of Melbourne now in course of electrification. The scheme requires about 800 carriages to be operated on 150 miles of route and 290 miles of running track. The general information is classified under the following sections :—Electric lighting, power and traction ; telegraph and telephone ; manufacturing and miscellaneous ; Colonial and British possessions ; directory of officials, of members of electric lighting and tramways committees, and of electrical contractors ; index of undertakings ; buyers' guide. Preceding the aforementioned sections are one hundred pages devoted to " Progress of the Year," comprising statistics, articles, Parliamentary proceedings, general survey, etc. On whatever subject one searches this and other sections for information it is forthcoming. There are even statistics of electrical accidents and mains explosions, and a list of all railless trolley systems of electric traction for which powers had been granted up to January last. These number 29, but twenty of them have not been opened for traffic. Reference is also made to the work of the Electrical Vehicle Committee, and valuable chapters are those which give a list of our electrical imports and exports and refer to electrical progress in Belgium and Germany.

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THE
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The Congress.

Although the attendance at the Congress of the Tramways and Light Railways Association was affected by the difficulties that the war has imposed on the conduct of traffic undertakings, some very important business was transacted. The action that the Council had already taken in their endeavour to ease the burden met with unanimous approval; and the Congress authorised them to approach the Minister of Munitions with the urgent request that men in the repair shops and power-stations should be classed as being engaged on public utility work. Unless this concession is obtained, the time must come when the services will be completely disorganised, and power will not be available for running machinery in munition factories or for public and private lighting. Any further impediment to traffic must interfere with the conveyance of war workers, to say nothing of the general public. Already there are some towns where business men are rendering voluntary assistance as motormen and conductors during the rush hours. In addition a large number of tramways are employing women as conductors. No doubt it was due to patriotic motives that the Congress refrained from including car crews in the list of workmen to be regarded as exempt from military or munition service. Yet no harm would have been done if the Council had been instructed to apply for tramways to be placed in the same category as railways, and to ask that the sanction of managers be required in the case of enlistments. Turning to the Congress papers, it must be conceded that they will each afford managers, directors, and committees an abundance of material for consideration. To the hundred and one practical points comprised in Mr. Mason's "Glimpses into the Obvious" it was impossible to give adequate discussion. His reference to the work of inspectors resulted in a debate as to the best manner of selecting those officials. To be of use they must be men who in the discharge of their duty shall be influenced solely by a regard for the interest of their employers, and if the inspectors are wise they will not be slow to take the lesson of the discussion to heart. In order to render the tramway service attractive it is probably advisable that promotions should be made to the rank of inspector instead of recruiting their ranks from outside. On large systems a periodical change to other routes is one method of keeping inspectors up to the mark, but it would appear that when a number of tramways are owned by a large company, changes from one to another do not at present result in the best man being appointed. Possibly the remedy may be found in a graduated scale of salaries. A striking point in Mr. Dugdale's paper is the contention that the granting of soldiers' dependants' pay ought to have been made a subject of a conference between representatives of municipal and company-owned tramways. A number of reasons can be advanced in favour of that course, and also for the further plea that uniformity should have been arrived at in the amounts given to dependants by the various departments of a municipal authority, and the burden of the expenditure divided among them either equally or *pro rata*. Mr. Watson's paper on battery vehicles as an adjunct to tramways does not call for detailed comment; the best commentary is provided by the experience gained at Southend, South Shields, and York, while further evidence will in a short time be forthcoming from West Bromwich and Loughborough.

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Emergency Extension of Parliamentary Acts.

The Special Acts (Extension of Time) Act which was passed unopposed through Parliament just before the adjournment for the recess promises to be a very useful measure for tramway authorities and other bodies. It provides that where the time within which a power may be exercised under any Special Act is limited, an application may be made to the appropriate Government Department for an Order extending that time, but only in cases where the time is due to expire within twelve months of the date of the application. The Department, if satisfied that the time should be extended, may make an Order to extend the time, but the extension allowed is to be for not more than a year. The Act is to remain in force during the period of the war and for six months after. In this way what threatened to be many hard cases are met. It will be remembered that the Government have enjoined local authorities and companies holding statutory powers for new works to delay wherever possible the carrying out of these works till the war is over, and for this purpose the Treasury will not sanction the raising of additional capital except in cases where the new works are an urgent necessity. The construction of various authorised tramways, among other things, has been hung up in consequence, and promoters were in various cases faced with the necessity of bringing forward Bills in Parliament for the special purpose of extending the time allowed. To prevent the delay and waste of money which would be involved in that course, various bodies concerned approached the Government. Among those who did so was the Council of the Tramways and Light Railways Association. Mr. H. England referred to the fact at the recent annual conference of the Association, and it is gratifying that the Government responded so promptly to the call. The getting of an Order for an extension of time from a Government Department—in the case of tramways, the Board of Trade—should be a very cheap, convenient, and speedy method compared with that of promoting a private Bill in Parliament. The advantage is the greater because in these times of war it is hardly likely that any Bills for authorising further new tramways will be brought forward, so that if time extension by Bill had to be sought it might often have to be by a Bill for that sole and express purpose, which would have been a very wasteful procedure.

Wear of Rails.

Two papers read and discussed during the last session of the Institution of Civil Engineers treated of the wear of rails on electrically worked tracks. Mr. W. Willox examined the causes and effects of the trouble as experienced on railways, resulting in long undulations called "battering," while Mr. Stephen Sellon confined his remarks to the shorter waves or corrugations on tramway rails. Railway tracks are more or less springy, whereas the aim of the tramway engineer is to have a road uniformly solid and rigid, in order to keep the rails as nearly level as possible with the road paving. Moreover, the permanent way in the open is comparatively free from dust and dirt, but rails in tunnels and "tubes" suffer to a certain extent from the settlement thereon of metallic dust caused by the wear of the rails. On tramways the dirt brought on to the rails by the road traffic is a continual source of trouble. It is only partially mitigated by rain and watering, as the detritus when washed off the heads of the rails settles in the grooves and is squeezed out again by the wheel flanges. These differences in the conditions make it almost futile to compare the two problems to any advantage. The effect of the rolling stock is indeed similar in both cases, but the effect on the rolling stock itself was practically ignored by the speakers. Now the causes of the excessive wear of rails common to all electric lines not worked by locomotives are simple enough. In order to give as much seating capacity as possible, and for other reasons, the propelling machinery is kept under the floor of the coaches, and the wheels are of very small diameter. Consequently the motors and gear are not spring-borne, and the centre of gravity is very low—so low, indeed, that the proportion of the side thrust to the weight borne is enormously increased as compared with that obtained by locomotives whether steam or electric. The running on all electrical lines worked by separate engines is quite smooth at every speed, and no wavy wear occurs. Another evil due to the present design of the multiple

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unit rolling stock is the position of the motors near the outer ends of the axles, their asynchronous working, the difference in diameter of the wheels on the same axle, and the unequal action of the brakes at each end. These causes result in skidding or slipping both longitudinally and transversely. Failing improvement in rolling stock, the only possibility of minimising the destructive effect lies in improving the permanent way. In the "tubes" a centre length of the sleepers is bedded on concrete laid on the cast-iron floor; the ends bearing the rails overhang, and are packed with ballast. This gives a uniform springiness to the road, and no waves appear. It is this uniform elasticity which is the best corrective of wavy wear. On the other underground lines no such practice is possible under present conditions, and nothing is left but to increase the resistance of the rails. The use of Sandberg high silicon steel rails has greatly increased their life on all electric lines, but even these have not proved as efficient in some places as those of rolled manganese steel. These have proved more durable, and in spite of their great cost prove economical in the end, and they save the cost of frequent renewals, and, what is quite as important, the difficult, dangerous, and expensive labour on lines where the traffic is as intense, the room for working as small, and the intervals between trains as short as on the Underground system. Several thousand tons of rolled manganese steel rails have been laid on the New York, Chicago, and Philadelphia Railroads with most satisfactory results, and their use is rapidly extending in the United States.

INCREASE OF FARES OR A TRAMWAY RATE?

This is a time when something ought to be accomplished in the way of increasing fares to make up not only for too liberal reductions in the past, but also for the higher cost of materials and labour that has come to stay for a much longer period than the duration of the war. The second greatest reductions in fares made upon any tramway system in this country was instituted by the London County Council two years ago, in order to meet the competition of the motor-omnibus companies. These vehicles take the cream of the traffic from 8 a.m. without doing anything towards the transport of any of the 46 millions of persons who last year paid workmen's fares, ranging from a penny single to twopence return. No blame can be cast upon the omnibuses; the censure should fall on the rival parties who twenty years ago made the tramways a pawn in the political game of outbidding each other for popular favour, with the result that the fares charged up to half-past seven in the morning were placed at a figure unheard of anywhere else in the world. On the majority of routes the workman's return ticket conveys its owner a dozen miles or more, while in one case nineteen miles are given for twopence. Of course, this exercise of charity at the expense of the ratepayers has had a wonderful effect in creating suburbs, badly planned though they are, to relieve congestion of population caused by the lack of small houses in central London. But, with the prospect of the tramways becoming a charge on the rates next year, the time has arrived when the workmen's single fare ought to be raised to three-halfpence and the return to threepence. That course will not, however, restore the financial equilibrium, and rather than allow the undertaking to come on the rates the Council ought to put back to the old figures the fares charged for return tickets. These entail reductions of a penny for three distances. Prior to the war there were indications that these reductions were attracting back some of the people who used the omnibuses, and before the late strike of the tramway employees the outlook had been rendered more hopeful on account of the impressment of a large number of the rival undertaking's vehicles. Latterly the receipts have begun to show weekly increases of from £1,600 to £2,400, but the total receipts for the year are not likely to give such a return as ought to be earned on the aggregate of nearly 551,000,000 persons carried last year. A very large number of the passengers belong to the classes who have secured higher wages since the war began, and it will be no hardship to anybody if the tramways undertaking is allowed to recoup itself for its higher working costs. No difficulty has been experienced in that respect since the Birmingham Corporation raised the fares in order to avert the possibility of a deficit next March, and the same indication of public approval ought to be given to the Leicester Corporation in the similar step they have recently taken. And what necessity can there be for the latter authority to continue to give free rides to soldiers? It is not done now by any traction undertaking in London. In Leicester the privilege has cost £5,000, and its discontinuance would enable the tramways to get through the present year without a deficit, which is estimated at £3,000 even when the fares have been increased. The war is expected greatly to alter political and social conditions. A change has already come about in the view taken of municipal tramways policy if the adoption of the Leicester Committee's proposal by 38 votes to 17 may be regarded as a typical instance. The majority were well advised in declining to incur the risk of having to impose a rate of fourpence-halfpenny, and we hope that their example will stimulate other Town Councils to take steps to prevent their tramways becoming a charge upon the rates.

Unprofitable Season Tickets at Blackpool.—In his annual report Mr. C. Furness, general manager, Blackpool Corporation Tramways, gives a table showing that contract tickets numbered 922 in 1911, bringing in £2,516, while for the past year the figures were 1,466 and £4,145. "There is an alarming increase," Mr. Furness says, "in this particular source of income. During 1915 the number of contracts issued increased by 218, and the revenue by £645. The time is fast approaching when this concession should receive consideration, as contract ticket holders are being carried at less than the average operating expenses per passenger. The following figures are taken from a recent census of receipts and passengers carried. During one week 37,000 contractors and 156,000 cash passengers were carried, the average fare per passenger respectively being 0·52d. and 1·5d. In support of the previous statement, it might be mentioned that the average operating expenses per passenger work out at 0·79d., and therefore these contract passengers are being subsidised in their car riding at the expense of the ordinary fare-paying passenger, to the extent of one farthing per journey."

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Tramways and Light Railways Association

Full Report of the Seventh Annual Congress, held in London, July 16, 1915.

The eighteenth annual ordinary meeting and seventh annual congress of the Tramways and Light Railways Association was held on Friday, July 16, 1915, at the Institution of Civil Engineers, Great George Street, Westminster.

The Hon. ARTHUR STANLEY, M.P., chairman of the Council, presided, and before moving the adoption of the report said:—

Gentlemen, it is within your knowledge that owing to the war the Council determined to curtail this year the proceedings of the annual congress, and instead of having the two or three days which we generally devote to it somewhere in the country, where business and pleasure mingle, we decided to hold it this year in London. There will be this business meeting this morning, and there will be an informal dinner this evening. Some of our members have kindly offered to give us some papers, which will be read and discussed at this meeting. There are some gentlemen here who are not members, and to them we extend a hearty welcome, and especially to the members of the Municipal Tramways Association. I will now call on the secretary to read the notice convening the meeting and the auditor's certificate.

The SECRETARY (Mr. A. de Turckheim) then read the notice convening the meeting and the auditor's certificate.

THE CHAIRMAN'S ADDRESS.

THE TRAMWAY INDUSTRY AND THE WAR.

REPRESENTATIONS TO THE MINISTER OF MUNITIONS.

The CHAIRMAN: I will now proceed to say a few words on the report and accounts. The revenue from subscriptions amounted to £832, against £805 last year. This again constitutes a record, and had it not been for the war there was every reason to believe that the yearly progress would have been more than maintained. The expenditure during the year amounted to £822, as against £657, an increase of £165, due to the fact that we incurred some special expenditure which we would perhaps not have done had we foreseen this war. The net result was a deficit on the year's working of twenty-one shillings and sixpence, but we carry forward a surplus from former years of £300, which we have since invested in the War Loan. (Hear, hear.) We can hardly hope to keep up our revenue this year, as, of course, many of our members have joined His Majesty's Forces, some have resigned their membership, and new members are hard to obtain in these abnormal times. Before going further, I should like to refer to two matters; first of all to the severe losses of old friends through death during the year. The three members we have lost were three of the earliest members of our Association, and all three had at some time been members of the Council; I refer to Mr. Thomas Holliday, of Hastings, and Mr. Gordon and Mr. Tresilian, of Dublin. Mr. Tresilian was on the Council at the time of his death. Our deep sympathy goes out to their relatives, and in the case of the two latter gentlemen, to Mr. Murphy, one of our vice-presidents, whose right-hand men they were. You will all remember how kindly we were welcomed at Dublin some years ago by Messrs. Anderson, Gordon, and Tresilian, and it is sad to think that all three have now passed away. The next matter I wish to refer to is our congress at Newcastle last July. Through a series of most unfortunate but unavoidable circumstances it happened that at the last moment our president, our chairman, and our vice-chairman were prevented from attending, and I am anxious, especially in view of the most friendly and generous welcome you all received then, to state publicly how sorry I am that this should have occurred. I wish to express to Alderman Rodgers, Councillor Mayne, and Mr. Hatton, and to the members of the various local companies, our deep regret, and on behalf of you all our sincere thanks for the way in which they entertained us. I hope that we shall have an opportunity when this war is over to have them here as our guests, and to prove to them that we are neither ungrateful nor unappreciative.

Well, gentlemen, in spite of the war we have been able steadily to carry on, and we have, I think, done useful work for the tramway industry. We have several committees sitting at present, and we have recently had an opportunity of giving evidence before the Local Government Board on questions relating to the maintenance of tramway tracks. Our thanks are due to Messrs. Edwardes and Goodyer, who worked very hard, and who ably represented the Association. We may hope that some official effect may be given, if not to all, at any rate to some of our recommendations. During the year one of our Special Committees submitted a carefully prepared and useful report on tramcar controllers. This we sent to the Board of Trade, whose acknowledgment of our efforts we duly received. At the present moment the Association is in close communication with its tramway managers and others responsible for working the various systems on the subject of supplies during war time. Your Council, fearing that there might be serious delays in the supply of materials such as steel tires, etc., on the part of those manufacturers whose works have been taken over by the War Office, are considering the question of approaching the Munitions Department with a view to insuring a sufficient supply for stock, so as to prevent any possible stoppage of tramway services. It is hard to conceive what the conditions would be in the various tramway centres if tramway traffic were suddenly to cease; and in this connection your Council have passed the following resolution:—

> "Resolved that in view of the serious situation which has arisen owing to the restriction of output, and the difficulty of transport of materials essential for the maintenance of tramway services, and in order that the great national and public utility of these services may not be jeopardised, the Minister of Munitions be requested to receive a deputation from this Association at an early date."

We hope to arrange without delay for an influential deputation to state our case as forcibly as possible. I know it is our experience in Lancashire, and I think it is the experience of gentlemen in other parts, that those who have had to remain at home are doing their best to help the companies to fill the places vacated, and to do the extra work thrown upon them by the absence of their comrades in the field. It is gratifying to know how loyally tramwaymen all over the country are assisting in this war, and what a large proportion of men are now fighting for their country. This, of course, entails more work and longer hours for those remaining at home. I beg to move that the report and statement of accounts for the year ended December 31, 1914, be approved and passed. I will ask Mr. England, the vice-chairman, to second that, and then we shall be very glad to answer any questions that may be asked. (Applause.)

The motion was then seconded by Mr. ENGLAND, and was carried unanimously.

The CHAIRMAN: This is the period when, according to the requirements of our Articles of Association, we must lose one-third of our members of the Council, and we shall all be sorry to lose such old friends as Messrs. Coutts, Edwardes, Fell, Parshall, Thom, and last, but not least, Mr. Tegetmeier, one of our Swansea hosts. We thank them for the help they have given us during three years, and we hope to see them all back before long. In addition to these six vacancies, your Council have a further one to fill, caused by the death of Mr. Tresilian, making seven in all, and the Council unanimously recommend to you the following names for election to-day:—

Mr. J. B. Tippetts, of the British Electrical Federation.

Mr. Ernest Hatton, general manager of the Newcastle Corporation Tramways.

Mr. H. L. White, general manager at Great Grimsby.

Mr. C. D. Stanley, general manager at St. Helens.

Mr. James Devonshire, managing director of the Metropolitan and London United Tramways.

Mr. W. T. Robson, general manager of the Southampton Corporation Tramways.

Mr. W. G. Verdon Smith, managing director of the Bristol Tramways and Carriage Company.

I am sure that you will agree with me that these gentlemen will be valuable additions to our Council, and I move that they be elected members of the Council.

Mr. A. L. C. FELL: I have much pleasure in seconding that.

The motion was carried unanimously.

On the motion of Mr. H. L. WHITE, seconded by Mr. H. P. CONIBEAR, the retiring hon. auditor, Mr. A. W. Chambers, was unanimously re-elected for the ensuing year, and the thanks of the Association given to that gentleman for kindly placing his services at the disposal of the Association.

The CHAIRMAN: This concludes the business of the annual meeting, and I beg the Association now to excuse me. I have another meeting in connection with Red Cross work, and I will ask the vice-chairman to take my place.

THE SEVENTH ANNUAL CONGRESS.

Mr. Harry England, vice-chairman of the Council, then took the chair and opened the seventh annual congress.

Mr. A. V. MASON (general manager and engineer of the South Metropolitan Electric Tramways and Lighting Company) submitted the following paper:—

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GLIMPSES INTO THE OBVIOUS.

By A. V. Mason, M.I.E.E.
(*General Manager, South Metropolitan Electric Tramways*).

The secretary has suggested that the conference should be held as usual, but without dinners, speeches, or séances in smoking-rooms, and has also asked for a volunteer for a paper. I thoroughly agree that the conference should proceed —other societies are doing it— and having some considerable time on my hands (not in the office, unfortunately, but as a policeman in a little hut, with a pipe on), I venture to break away from the traditions of this association, and give, not "Rambles Round Surrey," but "Rambles Round Tramways." I will not mention any names, and I trust that it will *not* be accepted that *I* am the perpetrator, even if I have adopted most of the ideas mentioned; but as the meeting is an informal one for tramway managers, perhaps this "ramble" will not only bring forth criticisms from my other active brother members, but ideas that may be useful to us all.

"There is nothing new in the world." As I have said later on, this is a "bread-and-butter" paper, and maybe as such is below the dignity of our average member, and labelled "Glimpses into the Obvious." This expression is not original, but "poached." I hope in places it will be called "heterodoxical." Finally, I would say that I am not writing this from the point of view of the London County Council, or of any other large municipal undertaking, but from that of one of the average and smaller jobs where economy is one of the chief considerations.

Traffic, Books, Waybills, etc.

In the early days I think most of us entered not only the opening and closing numbers of the tickets sold on the conductor's waybill, but repeated it on the ticket and punch receipt; and, again, of those tickets sold in the traffic book —a terrible amount of ink slinging. Now the larger firms use an adding machine, but I cannot afford a machine of this type. A short cut without this is to enter the opening and closing numbers on the waybills only, allowing the conductor to work out his own bill so as to bank his cash properly, and then the office need only check his figures by jotting down the value of the number of tickets sold, in pence, bringing the aggregate to £ s. d. The totals of tickets sold only of each bill must be entered into a traffic book, and, again, the various route totals into a summary book, in order to get the necessary statistical data. The detailed ticket and punch receipt is done away with—purely a receipt for the box and tickets as shown on the waybill. If the waybill is lost, the numbers can easily be traced from the previous bill and ticket racks, if the latter are kept properly. The closing number on the expired bill should be entered as the opening number of the new waybill, and the tickets checked with the bill before the box leaves the office. As I have said later, ticket-holders save time in this direction. The last numbers in the ticket packs in the boxes invariably end in 00; labour and ink can be saved in the office if these numbers are printed on the face of the waybill. As we live on the third point of the decimal, every clerk should be taught in his youth to appreciate the value of the slide rule, both for costs and traffic analysis.

Bell Punch.

The best value, in my opinion, of this useful article is not, as in common practice, its secret register, clippings check, duplicate, or even triplicate sets per conductor, but its value as a running check.

The punch should deface the ticket, have a bell and an open register, and the indices should be put down with the ticket numbers at the same time, at least at the end of each trip. The clipping receptacles should be made so that they can be emptied without removing the seal, and then one punch per working conductor is sufficient with a few spares, as the punches need never go to the ticket office, except for occasional oiling and inspection.

Point Numbers.

The point number is the greatest deterrent to fraud, and is being given up on some roads. The Unions are now objecting to them, saying, "Our men are too busy, and not clerks, etc." I do not agree; but even if *at times* the conductors are too busy to put them down, this, *unhappily*, on most roads is *only* occasionally! No car, in my opinion, can be properly checked without point numbers.

The first column in the waybill for ticket numbers should have room for the four figures, but any subsequent columns for the point numbers should only contain room for a couple of figures. If this is done, and conductors put down dashes where tickets are not sold, there is very little extra labour; but if conductors persist in writing down all four numbers there is some apparent grievance.

The point numbers should not be numerous, but inserted at a point where the fares *should have been all collected*; by no means necessarily at an important stage, which is the usual practice, and, in my opinion, the *worst*, but some little way before the stage.

Tickets.

Many managers still keep separate tickets per route; one ticket increases flexibility, also shows thereon the stages "from" or "to," whilst the point the passenger rides "to" is only needed. The value of the ticket is shown chiefly by colour; but if the value is over-printed in large letters and a wrong one has been issued by mistake, passengers soon begin to think they are being defrauded, and clamour.

Work on ticket boxes in the office can be greatly diminished by having ticket racks properly built and numbered so that a series follows through one box, or part of a series, not from a common stock. Conductors should be taught to take out the same boxes; that is, on alternate days (this saves ticket disputes); but on week-ends we find that one box covers the two days as long as the same conductor uses it.

Inspectors.

The duties of an inspector are too numerous to detail. The common fault (not my own) is that of gold lace and beauty. It is at best a tedious job, and the main trouble is not the number of cars they check, but that the road is improperly covered. A *route diagram* on their checking sheet is useful to show graphically where and how the inspector spends his day. These inspectors cover the road, but the real deterrent to fraud is the "flying check" or super-numerary inspector, who travels by short cuts by cycle or by train. A private spot is invaluable, not for direct evidence, but it gives the manager a bird's-eye view of what is happening. The danger, of course, is they are soon *themselves* spotted.

Collection of Fares.

Every passenger thinks he is riding in his own private car, and that the conductor should follow him up the stairs to take his fare. Accidents can be avoided by the conductors being kept on the rear platform if passengers, when they dribble on the cars in ones or twos, will pay as they board along the route. It has been said that it breeds accidents. The man who is jolted off is not so numerous as the foolish woman (whom we all know) who rushes out from inside the car and gets off before it stops, because the car has not stopped at her side street, whilst the conductor is on top, and a claim follows. Good work can also be done by the collection of fares before the car leaves the terminus. The public are to blame, and need educating in this direction.

Witnesses.

We all know the hatred the average person has of going into court, or the prominence entailed by giving his name and address to a conductor before a crowd. Slips are invaluable, which are handed to the passengers, who will write down their correct address, especially if there is printed on the slip a notice that it is not intended for legal proceedings. These are made up in pads and put in the conductors' boxes.

Bells.

The question often arises in my mind whether a passenger should be encouraged to ring a bell to stop a car. They invariably ring the bell as if the car were on fire—and accidents follow. In the Croydon district we have two bells to stop, and I have found it to be a good practice to instruct the conductor to give a double two-bell signal when he wants the car stopped quickly; that is, with the hand brake, not an emergency stop such as for "trolley off," when they wish to stop between stopping places.

Fares.

I am not going to embark on the fare question, but there seems to be no doubt that there is money in "dumping" cheap return fares on long distance summer roads, viz., 4d. single, 6d. return; and an experiment I have often thought of trying is a return ticket from anywhere back to the spot again, so that the intermediate passenger could get the same convenience as the terminal passenger for a "joy" or "fresh air" ride. Children's half-fares (12 years of age and under) encourage traffic that would otherwise stay at home.

Apprentices' and school children's tickets up to 18 years of age also encourage traffic which might otherwise go by the railways. An annual identification ticket, obtained at the office, is issued to these persons at a cost of, say, threepence, which enables the holder to travel at half-fares going to and from school. This half-fare question is dealt with by punching ahead ordinary tickets, which can be done if point numbers are retained. The average workman is generally well catered for, especially on roads where "return at any time" tickets are issued, which is good business if the fares are within reasonable limits; but the shop assistant and regular rider after workmen's hours are not so well catered for. Weekly tickets at workmen's rates— travel one way before lunch and one way after — are a good concession to this class of travel over long distances where it is improbable that they will want to go home to mid-day dinner on the same fare. Good business, doubtless, could be done with cheap traffic facilities for the dinner hour in certain districts.

Season tickets and strip discount tickets seem to have been put out of court by abuse. It is a pity that we have to admit defeat by the inelasticity of our system. I trust that this is not another heresy! Personally, on many undertakings, I have always thought that the advantage gained from "seasons" would out-balance the abuse; but in connection with the strip ticket, with our present fare conditions and system of fares, and their collection, it is, I agree, purely a profit-sharing scheme with the conductor. In Canada ten years ago it certainly not only worked well, but encouraged traffics to a large extent, being able to split the coin of the realm in order to meet various traffic conditions.

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Advertisements.

Tramways never advertise their own goods sufficiently. Every available space not let to some trade advertiser should have some clean notice of "Advantage to Riders." The cars should be fitted with dashboards advertising "Fresh Air Rides," half-fares for children, concerts, theatres, etc., *free*. These spaces are of very much greater value for this purpose than any revenue from trade advertisements. I do not mean that the car should be plastered, and in London we are reasonably restricted.

Discipline.

The first principle for maintaining discipline is that no man shall be officially reported for an irregularity unless he be notified at the time, or as soon as possible. The "chit" system saves a lot of worry. On a report of any irregularity, either from an inspector, passenger, the office, or "shorts," a "chit" is sent out, and the delinquent returns it with excuses (and they are varied and numerous). These are filed, and when they get a pre-determined number the delinquent is seen and dealt with severely, chiefly by loss of seniority. This gets rid of tedious interviews, and furnishes a better method of punishment than suspension. Many managers, especially in the early days, were too fond of this form of punishment. It does little or no good, and by the "chit" system a man is hoisted by his own petard or the stupidity of his excuses. In other words, it is the merit or de-merit system without its inconsistencies or abuses

Smoking at "out" termini is a moot question; men will do it, and, personally, I have no objection to a man having a quiet puff as long as it is done unobtrusively, if it does not affect efficiency in other directions. I would rather recognise it than wink my eye at it. Entering public-houses I taboo altogether, even to get change. Every conductor should be provided with at least 2s. 6d. in coppers, and means should be taken to see that he has it by "spot check," and that it is not drawn on as "subs."

Free Travelling.

Members of the staff off duty should be allowed free travel as long as they get a pass from the inspector on duty. Half-fares for the wives and families of the staff is a concession worth consideration as long as it is accompanied by one of these pass-holders.

Seniority.

Now that the London police issue composite licences, it is advisable to appoint all men as spare men conductors. This saves duplicate spare men, motormen, and conductors, and the men can come into your service just as they are, over 21 years of age, unmarried, so that the average spare man's wage when he first joins will keep him, and when he wishes to get married he can be in constant work. Every man should be taken on with the understanding that if he cannot drive a car in twelve months he automatically resigns his position; this is in the interests of the public as well as of the company. This raises the important question of "schools." Doubtless on large jobs—it must not be forgotten that this "ramble" is not written for large jobs—schools, skeleton cars, etc., help a motorman to learn the internal workings of a car; but on smaller jobs, such as my own, all I ask is for a motorman to learn to drive a car as fast as the law permits, without accidents, and with as little current as possible. If anything goes wrong he has to carry out certain specified duties, and if they do not avail, to tie the trolley down and have the car pulled or pushed out of the way as soon as possible. Under no condition should the motorman be allowed to open up the boards or meddle with the equipment. A little knowledge is a dangerous thing, and the school course cannot be comprehensive enough to make the technical knowledge of much value, though on larger jobs it may be the means of making the individual man take more intelligent interest in his work. Harking back to the past, we all remember the man in the Black Country: "Bill, look at this car pushed along with a blooming fishing-rod," and from a traffic point of view this nearly suffices even to-day.

A bonus of 10s. to 20s. when a conductor obtains his driving licence is good practice. Every servant taken on should fill in a short examination paper to show that the rule book has been read. By the way, has anyone, bar the committee, ever used that "skeleton" we spent so much time over?

Loading Diagrams.

A quick, but, of course, approximate, way to ascertain the adequacy or inadequacy of the service is to put out on the road slips, instructing the conductors to jot down their punch indices at every hour. Curves can be drawn out from these quickly, and a bird's-eye view obtained. An open dial punch is needed for this. This method obtains just as good results as either dissecting waybills or having a man to count the passengers at predetermined places; it is also cheaper.

Wall Safes.

On some undertakings, where there are one or two auxiliary sheds, a practice which I have found to work well is to have a portable thief-proof safe with a mousetrap lid in which the conductors can drop their cash bags, with a spring lock, and the whole portable safe placed in a lock-up safe. This internal safe can then be taken out by the morning inspector and sent to the central offices and opened by the cash clerk, who alone has a key. This gets away from divided responsibility, and the conductor is directly responsible to the cash clerk. A night inspector who has other duties should not be burdened with cash responsibilities.

Payment of Wages

Envelopes containing a man's wages can be made up in the office and sent out sealed to the depots for payment, and the envelope used for a receipt.

Benevolent Fund.

Co-operation is of value. A payment of, say, one penny per week per member will stop the pernicious practice of "lists" by donations for deserving cases from the fund; also provides subscriptions to a local hospital for "out" and "in" patient letters. Letters for convalescent homes are a good investment, as are also some for Surgical Aid Societies. I will not enlarge on the value "*pro* and *contra*" of Social Athletic or Coal Clubs. This fund is also useful as a loan club, without interest, so long as weekly repayments are enforced.

Bread-and-Butter Tips.

I append here a few useful tips notices as a result of trips round the country. Perhaps these are common on all roads, but doubtless many can be added.

1. Everyone knows the nuisance of a conductor throwing the trolley rope down on passengers' heads at a terminus. A wooden or bamboo pole saves this if hung up at the terminus.
2. Hooks attached to the dash to secure the brake handles at the terminus are most useful, especially on gradients.
3. Mirrors fixed on the staircases showing the movements on top decks or platforms, and *vice versa*, should prevent accidents.
4. Motorman's seats are a novelty. These were common in Canada ten years ago, but have never come over here, presumably because we still work with the "hand" instead of the "air" brake.
5. A small 6 in. by 4 in. mirror, fitted above the motorman's head, enables him to see what is going on, not only in the car, but on the back platform. What we really want is a periscope for step accidents.
6. Boxes for disused tickets should be a boon to the public, as they keep the cars and streets clean, but they will not use them. It is said they pay for themselves in waste paper.
7. The London County Council ticket-cancelling punch is the finest innovation for transfers I have yet seen, as it does away with exchanges.
8. The staff greatly appreciate straw uniform hats in summer, but why a conductor should "ape" a soldier in the design of his uniform I never could understand; a postman's would be a much better model. Again, police cloth capes with oilskin aprons are very much healthier than heavy oilskins; they last longer, and are also very warm in winter. Warm in dry weather and dry in wet weather, I find they are greatly appreciated.
9. All door cupboards should be hinged from the top—a tidy practice.
10. Fixed main controller handles save accidents and are an economy.
11. Ticket boxes should be large, and have each kind of ticket separated with loose pieces of tin; the tickets need not then be tipped out for checking purposes.
12. A ticket-holder should also be provided with each box; saves time in the office checking the tickets.
13. The "Board of Trade" and "Stop by Request" posts could with advantage be painted different colours between the base and first collar.
14. Every manager knows the excuse that "the sand pin jammed." A simple, clever device is a foot lever, as on motor cars, designed so that they do not trip the passenger.
15. The tool question is a nuisance. A board containing pliers, screwdriver, feeder box key and monkey wrench, and piece of rubber is all that is needed. This is taken out by the first motorman and brought in by the last, each being responsible for its value.
16. The oil lamp invariably leaks. An old-fashioned ordinary candle carriage lamp suffices (or a C.A.V. set). A night-light in a converted hand oil lamp does.
17. When a satisfactory verdict is obtained resulting from a case of "obstruction," it should be advertised on the dash-boards, and cases of "failing to pay the fare" or "causing disturbance" should be posted on the car windows as a deterrent to others.
18. Bye-laws, instead of being stuck on the car doors or roofs, could with advantage be bound up in book form and put in a case on the car roof, held with a short brass chain—the longer the bye-laws the shorter the chain!
19. Whistles given to motormen are much more effective in clearing heavy drays and steam lorries off the track than the ordinary foot bell. The vernacular also helps "some."

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20. Clocks fitted as an advertisement in the cars are not only a good advertisement, but a real boon to the public.
21. We all know the trouble of shelters and their use by non-passengers. Why not fit up a ticket "penny-in-the-slot" machine therein, good for use of shelter and one ride that day of one penny value? The shelters could be checked by an inspector.
22. Trolley wire guards on open top deck cars, of bent iron painted aluminium, not only carry the lights for the top, but save people being bashed on the head by a lively conductor changing the pole, and very likely save more serious accidents in the form of breaking poles or live trolley wires falling. They should be well earthed.
23. Most concerns still use the red lamps for the trolley poles "alive" signal. A good practice is to have an auxiliary testing connection with a spring switch, so that the circuit can be tested as a matter of routine when the car is taken out.
24. Reversible, removable advertisement board for the dashes enables the matter to be kept up to date and tidy, and a standard advertisement ready to be exhibited.
25. "Combined" undertakings can effectively advertise the lighting department.
26. I won't waste time over meters. I have latterly tried a bonus system of paying 1s. a week to every motorman who keeps below the prescribed limit, with so far satisfactory results. I mention this because the system evolved by my assistant is, I think, novel where different cars are used. An account in the aggregate of the total units allowed each day per type of equipment is kept of each man, with a daily plus and minus, so that if he has one unit in hand at the end of the week he gets his "bob," making due allowance for genuine excuses.
27. It is a good practice to make a motorman drop his lifeguard gates as he sheds a car; no essential part of a car gets stiff quicker from lack of use.
28. A skate fixed at predetermined points, connected to an ordinary ammeter or voltmeter recording chart, provided with a pricker and solenoid working electrically, records bad time-keeping.
29. Where the tramway terminus is in a side street, or the car is hidden from the main thoroughfare, an overhead skate is also useful if connected to an illuminated sign worked by changing the trolley pole electrically. This shows intending passengers whether it is worth a "hustle" or not. Nothing is more annoying than to saunter and lose the car, or hustle and wait.
30. Illuminated large glass signs attached to the trolley standard at junctions, termini, etc., are an advantage over the painted boards.

The last glimpses into the obvious are the value of clean and tidy cars. In London we have to thank the police for this; for not only have we to revarnish the whole car once a year, but our advertisement spaces, thank heaven, are restricted. High speeds are also important; a motor-'bus system running alongside the tramcar soon gets one out of any temporary lapse into lethargy. It may even be desirable to re-motor the cars; but a lot can be done by getting a hustle on staff, management, and the public without going to this expense. Brightly lit cars are a blessing; with the modern day metal lamp everyone ought to be able to read well. And, lastly, there is the question of the "personnel" of the staff; the necessity and the difficulty of getting them to keep their uniforms well brushed and their buttons bright.

Cleanliness, cheeriness, and courtesy are the tramwayman's three "R's" in life; and if the management provide clean and bright cars, with good uniforms, the men soon respond. I am a great believer in the upkeep of the rolling stock in this respect—whatever the town or the locality—only we have been wrong from the commencement in copying a circus roundabout with our gaudily-painted cars and clothing our men like lancers. A car of natural colour woods, stained and varnished, and built on scientific principles for easy repairs against scratches and bashes would have been much more suitable, and the staff clothed in neat uniforms, without gilt buttons or red, green, or blue piping.

Conclusion.

I would take this opportunity of apologising sincerely and humbly for my poaching methods, but the preserves are not always well guarded, and the paper is only a "ramble"; and I would thank the various owners, especially one old friend not a thousand miles from Croydon itself. Also I would thank my own staff for their constant temerity in not only devising schemes to make our small undertaking more efficient, but also for their poaching habits, and for making me adopt them. I hope I have achieved the object of "drawing" not the badger, but some North Country gentleman to follow my line and read a paper on "Engineering Tips."

The Chairman: The paper is open for discussion. Plenty of criticism can be levelled at it, and by a free expression of opinion we shall all benefit.

Discussion.

Mr. E. Hatton (general manager, Newcastle-on-Tyne Corporation Tramways): I think this is a most interesting paper, but the author has raised too many points for one to discuss all of them. He says that any witness in court is better than none. If he had been with cases in either county courts or assize courts like some I have been in, he would think in some instances his case would have been better without them. As to the bell punch and the working of the ticket bell punch, I cannot say I entirely agree with him. We spend a lot of money in this way which I think could easily be curtailed. When there are many routes, to check them every hour, as he suggests, instead of taking a proper census, would not give us anything like the facts we want in order to ascertain where to put on more cars or where to take cars off. The ticket printing punch is, I think, very ingenious, but it is such a complicated piece of mechanism that one could not keep it in repair I suppose for more than two or three hours. I quite agree with Mr. Mason that all men should be trained to drive and also to act as conductors, although we get many men whom we could not take on as drivers in the ordinary course because they are too small, and we have many men acting as conductors who are of a lower standard of height than the drivers. We find that these smaller men are often very much handier than the taller ones, and we would not wish to debar them from becoming conductors as would be done if we maintained the same standard of height both for conductors and drivers. As to the suggestion of the employment of single men only for spare duties I agree with Mr. Mason very largely, but some folks must get married to maintain the population. We used to give spare men 15s. a week when I was in Salford, but you cannot get them at this rate nowadays; we in Newcastle have to pay them full wages according to grade, but one has to keep the number of spare men down to a minimum owing to the expense involved. I am inclined to think that in the years to come, owing to this war, it will be more difficult to get such men. They certainly will not come for 15s. a week, and what is more, if they did, I do not see how you could expect them to be honest. Men employed on part time have to live for a week even if they have worked only for three or four days. In London you have, of course, many conditions which are different from those in the provinces, and I will, therefore, not touch further on this question. Inspectors in one sense of course one has to have them—are a sort of necessary evil, just as a pattern shop is in an engineering works. At the same time inspectors are absolutely essential, and theirs is a tedious job. What is more, it is a hard job if they do their duty properly, as the men have to move about all day. We always promote our own men to be inspectors, any capable of performing the duties, but I do not think that this is good practice. Inspectors ought to be obtained from other tramway systems on satisfactory recommendation, and this could be done all round the country. I mean, of course, afterwards to keep them permanently, if satisfactory.

The Chairman: They ought to move on in exchange.

Mr. Hatton: Quite so. With regard to allowing passengers to ring the bell we let passengers stop the car, but we do not let anyone start it; we fine them if we catch them at it. There are so many points touched upon in the paper that it would take a week to go through them all, or at any rate to get one's notes ready before one started adequately to discuss the paper. But I quite agree with the author of the paper about maintaining the car in the best possible condition. Unfortunately at present it takes us all our time to maintain the cars in workable condition even to keep reduced services going, but when the war is over we hope to get them back again into proper condition. Unquestionably it is good policy now to keep things as fit as possible. With regard to illuminated signs for stopping places, I think it is a good idea to provide them if they do not cost too much money. There are many other points I could speak of, but I have already talked too long.

Mr. C. D. Stanley (engineer and general manager, St. Helens and District Tramways): I will take in detail one or two of the points Mr. Mason has raised. As regards the passenger ringing the bell, I am convinced that it ought not to be allowed, either for stopping or starting. Mr. Mason says they ring the bell as if in case of fire, and accidents follow. But they have, if they wish the car to stop, two bells, but certainly with the starting signal the proper person to ring the bell is the conductor. Coming to the matter of drivers' spare lists, I agree that if anybody could devise a method for doing away with the spare list, it would be an unmitigated blessing. The conductors' list is all right; young men can afford it, but drivers, being mostly married men, cannot live on a spare man's wages, at any rate nowadays. In regard to the married men, I do not quite agree with Mr. Mason preferring to take all single ones. I find married men as a whole more reliable and stable—the married man has got some stake, something to lose; but with the young single man very often something annoys him about his job, and he gives it up and leaves the car. A married man as a rule does not do that. On the matter of witnesses, Mr. Mason says that any witness is better than none; to a great extent I agree with that. In the cases of accident, you very often get a statement or conductor's report that there were so many passengers in the car but none of them saw it happen. I always impress upon the conductors that it does not matter whether the passengers saw it or not, get some names.

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Very often if you have got a few names you will subsequently find someone who did see quite a lot, or that possibly the whole point of the thing is whether the car was stopping or restarting, or whether it never stopped, and any passenger on the car can probably speak to that. With regard to speed, I agree as to high speeds being desirable for traffic, but I think that there is a limit to them, in that if you get them too high they play mischief with the cars, the points and crossings, the very worst things in car maintenance. There is, perhaps, one other point which might come under the heading of this paper which has not been mentioned, and that is the matter of chains or gates for platforms. We have certainly had to put chains on in consequence of the very serious overcrowding from military traffic, and I believe that they are fairly universal, chains across the platform steps. But there is just this one other point. I find it also necessary to put a chain across the driver's platform step; they unquestionably prevent passengers coming on that way, but if you have got a really crowded car, no sooner does it get started than the passengers begin to dribble down from the top deck by the stairs, and you may have to stop two or three times in order to clear the driver's platform. A short chain across the bottom stair is quite useful. Of course, I know they can get over or under it, but the fact of its being there alone sets a limit. It is a practical point and has been a success.

Mr. J. W. DUGDALE (general manager and engineer, Oldham Corporation Tramways): On the question of point numbers, Mr. Mason stated that there were interferences or likely to be interferences from the Unions for having so many point numbers to record upon the waybill. So far as I am concerned I think that the Unions have nothing at all to do with anything relating to discipline. I do not think that is anything they have a right to interfere with. If a manager says that point numbers have got to be put down on waybills for the purpose of checking the cars, I think it is purely and simply a departmental matter. With regard to the inspectors, I agree with Mr. Hatton that the promotion of inspectors from your own men is a difficult proposition; and if a plan could be made or an idea suggested whereby we could get an interchange of men for promotion, I think it would be more conducive to the good of the department. Many times you may pick out a man for promotion, but he will say he does not like to report so and so because he has worked with him. That is not the class of inspector you want; I think you ought to have an independent man. When I was in Sheffield we had a clearance of inspectors, trained a lot of Army Service Corps men, and these men turned out exceptionally good men for us. There was fresh blood and new blood, and it seemed to put extra vigour into the concern altogether. A lot of cases were reported which were not got hold of before. With regard to the collection of fares on the platform, and the conductor having to go up and down the stairs and leave the platform, there are various ways of getting fares. In Sheffield I think they collect a good many on the platform. I am not an advocate of the pay-as-you-enter car in any way, but I think the fares can be collected by a man who knows his business without any trouble. Personally, I do not think that there ought to be any passes upon cars; I think every passenger ought to be a ticket-bearing passenger, even if you have got to have a kind of check in your office of free tickets. Issue them as cash, and when they come back after the day's run they should be crossed out. It is quite an easy matter of book-keeping. Then I agree with Mr. Hatton with regard to the spare list. I do not believe in having a large spare list. I think that every man ought to have a living wage. If you go back to the old days of horse cars and low wages, when they kept a good many men on the spare list and let them go away, as Mr. Mason says, with only 5s or 10s. a week, how could they expect honesty? If the spare list is kept down so that each man is able to draw at least 25s.—it is quite an easy thing to do—I think it is more conducive to the interests of the department. As to the payment of wages, there are envelopes upon the market now in which men's wages can be put and each man can see how much he is entitled to draw, and he can also see how much money he has got in his bag. You will have no trouble at all if you arrange that he shall make any complaint before he takes his bag away. I have been using that idea for quite a long time.

Mr. H. L. WHITE (general manager, Great Grimsby Street Tramways Company): The tips which Mr. Mason has given us with regard to certain matters are very useful. In reference to the waybills, it would save time if we had those oughts printed on our waybills. As to the bell punch, anyone having a transfer on their system will recognise that the bell punch as a check is practically worthless. In regard to the inspectors, I think in view of the fact that on many systems which are blessed or not blessed, as some people say, with a tramway men's union, it is very desirable that the inspectors should not be promoted from the ranks. I am afraid that Mr. Mason's suggestion that conductors should have slips to give to witnesses would not act very well. We all know the difficulty that conductors or motormen have in getting witnesses at all. The mere fact of them having to put down their names and addresses on a slip would probably impress them more than they are impressed at the present time that there is something behind it, and that they had better keep off. I think the best thing the conductor can do is to get names and addresses with as little fuss as he possibly can. With regard to the bells, we must all recognise that it is a very dangerous matter to allow passengers to ring the bells, but I am afraid it is one of those evils that we shall have to put up with, because when we have a car loaded with passengers, and the conductor on top getting the fares, it is a very difficult thing for him always to be going downstairs on to his platform at every stop to see that passengers do not pull the bell when they want to get off. I think it is one of those things we must put up with. I arrange on my small system that whenever the conductor rings the top bell on a canopy car it is the motorman's business to turn round and make sure the passenger has got safely off the platform. I find on the whole that that method works satisfactorily. I should be sorry to see workmen's weekly tickets at reduced rates adopted generally. All tramway systems have given sufficient facilities to workmen to travel, and most of us must admit that they are carried at a loss. I am sorry to hear Mr. Mason saying that he would recognise smoking at the termini rather than wink at it. I am afraid that if we give them an inch they will take an ell. With regard to free travelling, I should be sorry to see that practice extended beyond the right to travel free when going to and returning from duty. The suggestion about bamboos instead of ropes is one that I have found to answer very well. Mr. Mason's suggestion that the door of the platform cupboards should be hinged from the top is a very good one. Generally, I am sure that all these little hints and tips are very useful, and we ought to be obliged to Mr. Mason for having given us so many.

Mr. E. H. EDWARDES (engineer and general manager, Lancashire United Tramways, Limited): The question of bell punches is one which I have been considering for many years, and I am strongly of opinion that such punches are of very little service. A great number, I believe the majority, of tramway systems use them, and a proportion of them keep their register; but I know that many large systems, who go to the expense of these registering bell punches, do not look at the register at all, and I therefore cannot understand why such punches are retained. They are supposed to be a great advantage but, as the last speaker mentioned, on systems where you have transfer tickets, or where you have dated tickets, the registering bell punch is absolutely useless. (Hear, hear.) I know that some tramways have a most unstisfactory system of workmen's tickets in operation, through which many hundreds of pounds a year are lost. When a dated ticket has been suggested—thereby doing away with all exchange tickets—although it is admitted that that system is much better it has not been adopted, owing to the fact that it would upset the punch register. As to conductors booking up at point numbers or stages, I already have this system in operation and make the conductors book up at every stage. I know objection has been raised but, after enforcing the system, the men soon adapt themselves to it. The question of spare lists is, of course, one of the most difficult matters to regulate on any tramway, and it really depends largely on the management as to how many days' work your spare men get. You have now in all systems men who have one day off a week. If you tell off all those turns to spare men, that course will ensure a spare man receiving at least three or four days' regular work, and they can sometimes pick up another day or two, or even three days, in spare duties. On the system I am connected with, our spare list men average at least never less than five days a week, and sometimes they get six or seven. If properly regulated, they very often do even better than the regular men. As to the inspectors, I am much surprised to find so many speakers recommending that inspectors should be engaged from other tramways. Personally I would rather appoint a general manager of tramways than an inspector; it is a most hateful job to do, for whoever you appoint, you dissatisfy everybody. I am still of the opinion that your very best and most worthy driver or conductor should have a chance of promotion before any outsider. You say that these do not make good inspectors because they know the men. That assertion may be true or it may not. But if you get a stranger he probably will not be the best when you get him; he does not know the men the first week or two, but in another week he knows them and very often tries to be most lenient with them, because he wants to make himself popular. Therefore you are just as badly off in a month as if you had promoted one of your own men, and in addition you dissatisfy the drivers and conductors.

Mr. HATTON: Would not the better man get a job on some other tramway system if you have a little fresh blood?

Mr. EDWARDES: He would be fresh for a week or two, but the blood would soon mix up. Now as to the witnesses, I agree with Mr. Mason, having had considerable experience in settling actions during the past ten years. I must say that any witness is better than none. It is a most hopeless thing to take a case into court without anybody at all. I take it that the fixed controller handle to which Mr. Mason refers has a loose key; that I believe is the method which has been adopted by all controller makers.

Mr. R. J. HOWLEY (British Electrical Federation): There are one or two points in the paper to which I should like to refer. If the tramway business in this country is to keep its end up against the rapidly increasing motor omnibus, the cars must get along quicker. As long as you have conductors collecting fares on top,

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you must allow passengers to ring the bell to stop the car. The passenger's point of view has got to be considered. We are out to cater for their convenience, and it is not a bit of good making rules and regulations which are opposed to the interest of the public. The public will not thank you if, because the conductor is upstairs, they cannot stop the car when they want to get off and are carried a block further on. That rather leads to the question of collecting fares on the back platform. It has been very successful in America and some years ago I had an opportunity of seeing how they did it in Chicago. There, of course, the conditions are very different. They have a uniform fare of 5 cents and they have a platform which comfortably and safely holds eight or ten people. It is very difficult to work a platform collection of fares in this country. A conductor has a number of different tickets to issue and different fares to take, and in most cases the platforms only hold safely a few people; even then there is the danger of passengers being jerked off. We have tried to do it on our undertaking at Gateshead. We adopted the pay-as-you-enter system on a number of the cars. It has worked very well there, because the routes on which it is in operation are worked by single deck cars, and there is a universal fare of one penny. The difficulty came at the terminus near the High Level Bridge, where a large number of passengers crowd on together and delay occurred. Now at the terminus we allow the passengers to get into the car and take their seats. After that, if any passengers get on to the car, they pay their fare as they enter. That, I believe, to be a practical advantage, because after the conductor gets through his car he never leaves the platform. We certainly have found that it tends to reduce platform accidents.

Interchange of inspectors between undertakings would be very desirable. In our organisation we have tried to do it, but even then human nature comes in. If you apply to a manager for an inspector for another undertaking, he does not give you his best man—he often gives you a man he wants to get rid of.

With regard to the marking waybills at intermediate points I consider it very important and, curiously enough, my experience is that it is a matter on which there is a great difference of opinion. Mr. Mason, who is working an undertaking in South London, considers it of great importance, while I know other undertakings working outside London where they do not think it necessary to mark their waybills, even on long routes, except at the terminus. It makes it very difficult for an inspector to make a proper check of that car. Children, I think, ought always to be encouraged to travel by the issue of half fares. If you teach the children to ride, they acquire a habit of riding, and from a commercial point of view I think it is the right policy for a tramway company to adopt.

I cannot agree with Mr. Mason on the question of married men. My experience is that where you have trouble it is generally the young men who are at the bottom of it; you do not get the same trouble with the married men, who have got a family and who have got something to lose. In fact, the more of them you have on your undertaking the less trouble you will have. Free travelling, I think, should be restricted to men in uniform. I think to allow their families to travel free would be a mistake. We only allow men in uniform and the shed staff, who are provided with a special pass for the purpose, to travel free.

The question of speed, which I referred to at the beginning, is closely connected with the question of power brakes. I am of opinion that in the near future all heavy cars will have a power brake as a service brake. I do not think you can otherwise maintain a high average speed with a heavy car.

Mr. T. B. Goodyer (general manager, Croydon Corporation Tramways): I think Mr. Mason's paper has led to a useful and interesting discussion. I quite agree with Mr. Mason as to the utility of witness slips; I have adopted them and I find them exceedingly advantageous. I am very sorry Mr. White does not share that view. I regret very much to hear the expression from Mr. Edwardes with regard to the non-utility in his view of the bell punch. I should not have thought that any manager in these days would have submitted an expression of opinion on the lines Mr. Edwardes has done to-day, and that no manager of a tramways system would be without the bell punch in these times. I agree with Mr. Mason that a great deal of clerical work in respect of records and office work in regard to tickets has been eliminated by reason of the broader experience the different managers have been able to obtain. I have found a considerable reduction in my own records desirable. With regard to point numbers, I think that is essential. I quite agree with Mr. Howley that you cannot properly check a car unless you have point numbers inserted in the waybill before arrival at the fare stage. Mr. Mason, I observe, appears to be very generous in regard to his suggestion as to fares for children, workpeople, and students. It seems to me that that is a matter which can only be governed, or very largely governed to-day, by the average fare and the average stage distances generally which are in vogue. In that connection, I would like to congratulate Mr. Mason and his company on the fact that in the metropolitan area they receive the highest average fare per passenger that is obtainable in the area, and no doubt in that respect Mr. Mason can afford to be generous. I have been going into those figures, and I find if our average fare in Croydon per passenger was on the same basis as that of Mr. Mason's in the past year we should have taken something like £30,000 more. Looking at the matter, therefore, from that point of view, it must tell in favour of giving these indirect concessions. I have always held the view that one should make the fares rock-bottom, go as far as ever you possibly can, and eliminate altogether all these side issues of preferential treatment. (Hear, hear.) Then with regard to workmen's fares, of course, there is no doubt about it that on pretty nearly every tramway undertaking in the country these fares have been quite overdone. I agree with Mr. Mason that there is no reason at all why a man starting out at 5 or 6 o'clock in the morning should have preferential treatment over and above the man who by reason of his calling does not start his business until 8 or 9 o'clock and finishes correspondingly later. He is equally entitled to any privileges as the man who starts work earlier. I should like to congratulate Mr. Mason on his paper. (Hear, hear.)

Mr. C. J. Spencer (general manager, Bradford Corporation Tramways, and hon. secretary of the Municipal Tramways Association): May I just say that my gratitude is due to you, sir, for your very kind invitation to be present this morning. We of the Municipal Tramways Association are glad to greet you. I find myself in some difficulty at the moment for I have not had the advantage of being able to read all the papers presented to the congress this morning, but I have heard the discussion on Mr. Mason's paper, and from that discussion I gather something of the nature of the paper. I have further glanced through the paper in your Journal, and so far as I can gather Mr. Mason's paper is the sort of paper one likes to hear. It seems to be a little bit away from the usual run of papers, and deals with those detail matters which vitally concern us all. I am hardly prepared to traverse all the ground covered by the speakers in discussing and criticising the opinions of Mr. Mason. But two matters, however, have come into my mind in listening to this discussion. One is with reference to inspectors. Now we all know of course what difficulty we have in getting and keeping good inspectors. As a rule the average inspector in course of time becomes unobservant and automatic. He examines the tickets—he does do that but he does not see them; that is the trouble. He does not see the obvious things put right under his nose—that is my difficulty, and I believe it is the difficulty of practically every man who manages a tramway undertaking. On the other hand, one does occasionally come across a man who has special ability for the work; he makes it a sort of sport to track down the offending conductor or dishonest man. That inspector is a treasure when you get him. As to the policy of promoting your own staff to become inspectors or of getting them from somewhere else, personally I have followed for years now the practice of promoting members of my own staff. But I do not put that forward as being absolutely the best system, and it seems to me that it is governed to some extent by the size of your system. If you have a large traffic staff of drivers and conductors and so on, you can occasionally come across one or two odd men who stand head and shoulders above the others, and they make very good inspectors. But the difficulty generally occurs with a small staff, that these men work too much in collusion with their old colleagues. The subject is a difficult one. Somebody was talking about the spare list. Well, on some systems where they have spare lists, the spare list man turns up in the early morning; if wanted he is taken, and if not wanted he is usually sent home. I do not know how far that exists on tramways to-day generally, but I do consider it is a very bad system. The spare list, I suppose, on most systems is the gateway to the undertaking, and we are all desirous of attracting to our undertaking the very best men. If a man in order to enter the tramway service has to look forward to an uncertain job, which may mean anything from 4, 5, to 6 days a week, he is not going to leave a good job to take on tramways work; the man you attract under those conditions is the man who can get very little else. I think that is a very poor way in which to reinforce your staff. On the other hand, the establishment of a standard spare list with the guarantee of a reasonable week's work such as as we have may look like a piece of extravagance. I submit those are considerations governed very largely by the size of the undertaking; but given a sufficiently large undertaking your casual vacancies have a knack of averaging themselves throughout the year. You know something of your average sick list, something of your average accident list. It appears clearly enough that a certain definite percentage of the whole of the staff throughout the year is away, and it seems to me from those figures and facts you can devise a fairly scientific and accurate spare list in which you need have next to no waste. That is my experience, and it does provide a man immediately he enters the service with a good job that stands well with any other that he can get in the town. In that way you do attract to your undertaking pretty good men

Passing to another matter, I do not know whether I am in order, sir, but you will probably correct me if I am not. It bears on affairs during the war with which we are all concerned. Very special conditions have unfortunately fallen upon us. I heard from your report that your Association was asking the Minister of Munitions to receive a deputation to consider what could be done towards a guarantee of supplies of raw material for your repairs. That seems to me to be a very desirable thing, but, if I may suggest, it is only half the problem; in fact, I doubt whether it is half the

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problem. What I am thinking, and what most men are thinking, is the absolute shortage of the necessary skilled staff to keep our undertakings safe. (Hear, hear.) And if something does not happen presently to prevent the drain steadily taking place, it seems to me that there is going to be a very serious curtailment of tramway facilities throughout the country. Whilst we are tramway men, and whilst we look upon our own undertaking as perhaps being the most important in the kingdom, I do not think we have any right to say simply because we are tramways that we may prevent men enlisting, even if it leads to an absolute stoppage. On the other hand, if we are necessary to this great nation in this national crisis, it does seem to me that we ought to have proper recognition. I have been occupied, as secretary of the Municipal Tramways Association, in trying to get some definite pronouncement from the Government on that question. I have succeeded to some extent in getting from the Munitions Department a ruling, i.e., that so far as tramways are concerned in carrying munition workers they must be kept going. I have been trying to get a definite recognition for the men who are working our tramways.

A point of order being raised,

The CHAIRMAN: It is quite right.

Mr. SPENCER: I thought it might interest the conference.

The CHAIRMAN: We were going to deal with that question later.

Mr. SPENCER: That being so, it seems to me that some recognition is necessary, and if your Association have not taken in hand matters dealing with this, you may be interested to know just where we stand. From what I hear this morning, I am not quite prepared to say that it is final, but there is a very great chance of the Government recommending a war badge to those men who are not replacable and are necessary to carry on the tramways in towns having munition factories. I apologise for having kept you so long.

The CHAIRMAN: In proposing a hearty vote of thanks to the author of the paper, I have only one point to touch upon myself, a point which has been missed by every speaker, and that is the painting of cars. The final point of the paper is, I think, one of the most important, whether we should abolish a lot of gold leaf and transfers which we now use, and so save a good portion of the expense of painting. Whether we could stain the cars and varnish them I do not know, but there is an alternative to gold leaf—a black line. I think that is well worth trying. We might reduce expense and we ought to reduce expert labour on this class of work. There is no reason why our cars should not be as clean and as attractive if painted at half the present cost.

The vote of thanks having been accorded with acclamation,

The CHAIRMAN: As we have so little time, perhaps Mr. Mason will reply to the points raised in writing

Mr. MASON'S REPLY.

I will reply to the speakers collectively. Many of the criticisms were answered by subsequent speakers.

Witnesses.—The County Court is by no means the only aspect of accidents. The prominent one is "how little must we pay," and if a conductor does not get a passenger's name who actually saw the accident, those who were on the car at the time can either corroborate or refute the staff's statements as regards bells, speeds, etc. What a hopeless position one is in if one has no witnesses. Slips doubtless appeal to the better class passenger.

Spare Men.—The "spare man" has been a rankling sore in the industry since the first operating company of the ferry across the Styx. Since the Metropolitan Police have granted us composite licenses, I appoint every man as a spare conductor, next step service conductor, next step composite motorman and conductor, next step reserve motorman, next step motorman, next step deputy inspector, next inspector, next chief inspector. This only means one spare list, and the men have some object in the shape of promotion ahead of them.

Here I will explain that a spare man in bad weeks may occasionally draw only 15s. a week, but it must not be inferred that 15s. is a spare man's wage, for we pay 6d. per hour, and a spare man's "pick up" in the shape of wages greatly depends on himself being available. There are bad weeks as we all know, but on lean jobs one cannot afford Bradford, Newcastle, or other municipal methods. I have not been in the North for 15 years, but in the South a tramway man's job, being the lowest form of skilled labour—in that it has no proper apprenticeship—is attractive. Pay is better than in similar industries, and the work is healthy, regular, and not arduous comparatively, and worth going through the spare list for. I appreciate the married man—no man more—for he is more settled and doing his duty to his State, but I do not like married men at the bottom of the spare list, and I do not have them appointed if I can help it.

I am afraid the interchange of inspectors is impossible. Human nature is human nature, and if I have a "dud"—look out. It is like testimonials. (I never give an open testimonial, except of length of service.) The appointment of inspectors is a very difficult task. One can often pick the most suitable man, may be from the spare list, but I take in practice three factors:—(1) Length of service, (2) past record, (3) examination paper, tickets, car equipments, and feeding arrangements. Marks are given and appointment is made as reserve inspector first, and if he is unsuitable he is put back before he is appointed a full inspector.

The other matters that arose are more matters of detail. Of course the reversing key is removable, or what would the motorman do if he wants to hit an unruly passenger over the head—knock his canopy switch out or perhaps move a point? I was pleased to have some backing on the bell punch and point number question. Bells again are interesting. Should a passenger pull a bell? Yes, decidedly, if you are a passenger on anyone else's line, but not on your own.

This raises the point of limitation of damages. No innovation has bred so many accidents as bell ringing. I have seen passengers time after time ring the bell and get off before the car stopped or appreciably slowed up, thinking that the mere act of ringing the bell automatically stopped the car. If this method is going to be adopted and pushed extensively until the passengers get used to it—as dogs have now to motor cars—we must expect accidents. Personally I am a great believer in the education of collecting a large number of the top deck fares on the platform or at the terminus before the car starts, and I was interested to hear of the Gateshead experience. If this was done the conductor would spend more of his time on the platform and accidents would be saved.

As regards painting of cars, I believe Mr. James, of Swansea, has been exploiting a "giltless" car without any frills.

There is only one other point, that is, the danger of statistics. My average fare is nearly 1½d., but this is not due so much to high fares, though our fares are reasonably high, but if you carry a number of 6d. return passengers (11 miles), your average fare must be high. I quite agree that where 1d. fares extend over two miles cheaper facilities cannot be afforded, but where fares are reasonably high this dumping practice brings in more money.

Higher speeds were mentioned by a couple of speakers. In the provinces where the Corporations own the police as well as the roads, and slam, lock, and bolt the door to competition, cars can still meander along, but where the ubiquitous motor 'bus exists with its mobility and quick loading and unloading (small seating capacity), even with its lower maximum speed of 12 miles per hour against 16 miles per hour of the electric car in places, the vehicle that gets or even appears to get "a hustle on" gets the passenger. This is not only obvious, but pedantic, yet higher speeds are necessary if you wish to live against competition. Higher speeds do not necessarily mean higher *maximum* speeds, but effort on the part of the staff to get along the road quicker and get the passengers on and off the cars quicker.

I have purposely left out all references to war conditions. This is not due to lack of sympathy, but because of the paper from Mr. Dugdale. No one appreciates more than I do the noble self-sacrifice of our men who have volunteered in such numbers—more power to their elbow. I wish them a quick return to the old job—"perhaps on the carpet," with as ready a smile and excuse as in the past. I thank the members for their kind attention and criticism.

The following paper was then submitted by Mr. J. W. Dugdale, general manager and engineer of the Oldham Corporation Tramways:

TRAMWAYS DURING WAR TIME.

By J. W. DUGDALE

(*General Manager and Engineer, Oldham Corporation Tramways*).

The paper which I have been asked to put before this conference, and designated "Tramways During War Time," is one which is rather difficult to prepare, as the pure motive of conference papers should be with a distinct purpose of raising a discussion. I am afraid that such will not be the case to-day. At the same time, I will endeavour to make my subject as interesting as possible.

It is known to all heads of tramways that the total capital expenditure of the undertakings in the United Kingdom amounts to £80,977,838. It is therefore a transparent fact that the systems are a great asset to the nation, especially when the rateable value and the upkeep of the roadway are taken into consideration. At the present time great efforts are being made by the Government to obtain accommodation, men, and plant for the manufacture of munitions of war, and it is quite a common expression of thought that it would have been wiser had such arrangements been made earlier, and that leading business men should have been consulted by the Government. Workshops, railways, and motor cars appear to have been paced to the uttermost limit, but the military authorities have never once thought of taking into confidence, or of obtaining a single opinion, of any principal connected with any of our undertakings, except, of course, for free riding upon tramcars. I maintain that the advice of the chief officer of large systems of tramways such as London, Glasgow, Liverpool, or Manchester would be material and valuable in this great crisis. There is, in my opinion, plenty of scope to which our vehicles could have been put. The transport of the wounded, for instance, the removal of convalescent soldiers from various hospitals to convalescent homes, and the carrying of munitions in their various stages of production from one firm to another.

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The number of tramway employees who have given their services for this great European war reaches a total of 18,057, which is an average of about 30 per cent. of the total number of men employed on tramway undertakings. Every man has gone away with the comforting assurance that his dependents would be looked after, and that were he spared to come back his situation would be open for him. The cost to the departments mentioned for allowances or grants per week at the present time is very high; London County Council £1,568, Glasgow £1,000, Liverpool £520, and Manchester £1,360. The granting of payments to dependents ought, I think, to have been a subject for discussion between representatives of municipal and company-owned tramways at a conference.

This would have been the means of a more uniform rate of pay being adopted. In the case of the Oldham Corporation, the chairmen of each committee met as a special committee and decided to grant half-pay to the dependents of all married men, with a maximum of 16s. per week, and 10s. per week to the dependents of single men. Should the latter not leave any dependents, the sum of 10s per week to be accumulated in a fund, and the total amount paid to the man at the termination of the war or upon his discharge from the army. This is, as you will see, a very handsome grant, but the worst feature is that the most patriotic department of the Corporation is burdened with the heaviest expenditure. In the case of Oldham, the Tramways Committee at the present time are called upon to pay over £97 per week in grants, whilst another department will pay only 10s. per week. I am of opinion it would have been a much better arrangement if this burden of expenditure could have been by some means divided amongst all the departments of the Corporation, either equally or on some *pro rata* basis.

The members are aware that the staffs of tramway concerns throughout the country have been very seriously depleted, as I have previously stated, and in a great many instances the car services have had to be curtailed owing to shortage of labour A number of undertakings are experimenting with female labour on the cars, and in the near future this is bound to extend to other work in the department. I am not very much in favour of employing women conductors, unless it becomes absolutely essential, especially on tramways running early workmen's cars (which are generally overcrowded); and, again, I do not think that a woman is physically strong enough to bear the strain of ascending and descending the steps of double-deck cars for any length of time, neither is she capable of carrying out the heavy parts of the work of a guard. Of course the conditions of each tramway differ considerably. I notice that a number of wounded soldiers who have been discharged from the army are being engaged as guards, and are offered light employment in other departments of tramways undertakings. I have already a man who was wounded in the Battle of Mons, and I am prepared to take back all my wounded men who are capable in any way of performing even light duties.

Under present conditions it has become imperative for traffic employees to work a great number of hours each week owing to shortage of labour, especially motormen. I find in Oldham that the hasty training of men to fill these motormen's positions has been the means of increasing my electric energy bill as much as £20 per week for considerably less mileage. I have to pay 1¼d. per unit for energy, which is very costly, and I should not be surprised if this figure was increased, because it is common knowledge that the price of coal has increased enormously.

A great inducement is offered to motormen by the Government to work in the mechanical transport section of the Army Service Corps at the rate of pay of 6s. per day, with separation allowance, etc. I have had a good number of men leave me for this arm of the Service, but I may say the Corporation do not grant their dependents any allowance, as the army pay is so good. I have also experienced a fact that tramways who can afford to pay a high rate of wages per hour since the war commenced have been the means of attracting men from the lower paid systems, and in some cases the smaller paid tramways have suffered the loss of good and highly trained men, and this has been to the advantage of the higher paid systems.

The question of paying a war bonus to tramway and other Corporation employees has occupied the attention of the majority of committees during the past few months. Personally, I think that the Corporation employee (who is, in a great number of instances, in a much better financial position than an employee of a private firm, and who has regular hours, no short time, etc.) ought not to be granted this concession. It amounts to an additional tax upon the ratepayers, more particularly in rate-aided departments of a Corporation; and perhaps a ratepayer earning, say, £1 per week, will have to bear his share in paying a much better wage and war bonus to a man engaged in his own class of work in the employ of a municipality.

The employees in the different engineering trades in the workshops of tramways have, I believe, throughout the country been granted a war bonus by the Employers' Federation of 3s. per week to take effect during the period of the war. This I consider is not fair treatment to tramway undertakings, who are dealing so generously with their employees who have enlisted, and are granting free riding on the cars, to which I will refer later. There is, without doubt, a great scarcity of skilled men in every tramway workshop, owing to them having been drafted into private workshops engaged in manufacturing munitions of war. In the case of a large number of men in my department I have arranged for them to be transferred to the munition works nearest to Oldham where possible, so that they may be near their homes and families.

On the Liverpool Tramways munition work is being carried out very successfully; but I am of opinion that only the very largest undertakings could cope with such work, and at the same time keep pace with their own repairing and overhauling generally, which needs daily attention.

The fact must be borne in mind that tramway concerns are now handicapped in obtaining quick deliveries of material, such as car wheels, axles, tires, etc., and this has been brought about by the makers not being able to execute orders promptly on account of pressing Government work. The same applies to fittings for motor vehicles. I would state that a recent order I have placed for tramcar tires has been given at an increased price of 50 per cent. more than was paid twelve months ago and I may say I have been waiting three months for the delivery of an engine crank shaft. There is no doubt that tramway concerns will be called upon to pay very inflated prices for materials of every description. The copper market has already alarmingly increased.

For your information I give a few approximate figures in reference to the rise and fall in the price per ton of rails from the year 1869 to 1915, which you will see covers the years following the Franco-Prussian War of 1870 and the tramway boom of the year 1900:—

	Price per ton. £ s. d.		Price per ton. £ s. d.		Price per ton. £ s. d.
1869 ...	10 0 0	1885 ...	4 5 0	1901 ...	5 0 0
1870 ...	10 0 0	1886 ...	4 5 0	1902 ...	5 0 0
1871 ...	11 0 0	1887 ...	4 5 0	1903 ...	5 0 0
1872 ...	13 0 0	1888 ...	4 0 0	1904 ...	4 10 0
1873 ...	18 0 0	1889 ...	7 0 0	1905 ...	5 0 0
1874 ...	12 0 0	1890 ...	5 0 0	1906 ...	6 10 0
1875 ...	8 0 0	1891 ...	4 10 0	1907 ...	7 0 0
1876 ...	6 10 0	1892 ...	4 0 0	1908 ...	5 15 0
1877 ...	6 0 0	1893 ...	3 15 0	1909 ...	5 0 0
1878 ...	5 10 0	1894 ...	3 10 0	1910 ...	5 10 0
1879 ...	6 0 0	1895 ...	3 10 0	1911 ...	5 10 0
1880 ...	6 5 0	1896 ...	4 5 0	1912 ...	6 10 0
1881 ...	6 0 0	1897 ...	4 5 0	1913 ...	6 15 0
1882 ...	5 0 0	1898 ...	4 5 0	1914 ...	6 0 0
1883 ...	5 0 0	1899 ...	5 15 0	1915 ...	7 0 0
1884 ...	4 10 0	1900 ...	7 0 0		

There will be a great rush for tram rails in the very near future, as the life of those laid in the year 1900 on a lot of systems will become exhausted. This is a very important factor, which will have to be closely watched, as the prices per ton will increase considerably. Already tram rails have advanced in price to £9 5s. per ton. I am informed that the rolling mills in Belgium have all been destroyed by the enemy, and, of course, German quotations will not be entertained. The relaying of the permanent way on the Oldham Corporation Tramways has been suspended upon my recommendation till the end of hostilities, and this has been brought about by the high prices of material.

From the latest statistics compiled by the editor of the *Tramway and Railway World* I find that the total number of soldier-tramwaymen who have been killed in action, died from wounds, been lost from ships of the navy, or who have died from other causes since joining the forces is 214, of whom 186 were municipal employees and 28 were company employees. We may be sure that sympathy and care will be given their families and dependents. Their names will be honoured alike by their mates and former employers, and their relatives and friends will also have the consolation of knowing that these brave men died a noble death in the service of their country.

There must also be a large number of tramwaymen lying wounded at the different hospitals at home and abroad, and I think that the tramwaymen who remain at duty could not show their sympathy in a more tangible or suitable manner than by contributing regularly, say, each week a fixed sum to a fund for the purpose of providing a motor ambulance to be named after each town or tramway, which could either be used at home or abroad for the conveyance of wounded soldiers to hospitals and for other similar purposes. An ambulance, I estimate, would cost about £400, and if the tramway undertaking is at all large there ought to be no difficulty in raising in a very short time the required amount.

As you are doubtless aware, the people of the country are called upon almost daily to subscribe, either directly or indirectly, to some patriotic fund, and the response has been very creditable; but seeing that the average tramwayman is in receipt of a very much higher wage at the present time than he has ever received previously, I think, apart from the increased cost of living, he can well afford to contribute to purchase such a useful vehicle as a motor ambulance, even out of respect to his wounded brethren. I may further state that the tramways of the country have done their share in collecting contributions by means of boxes for the varied and worthy objects constantly requiring financial assistance. It is indeed seldom that you see a tramcar unless it is accompanied by some description of collecting-box.

A large number of tramways have granted free riding facilities to soldiers in training, wounded soldiers going to and from hospital, refugee children going to and from school, etc., and this concession has cost the Oldham Tramways Committee as much as £50 per week. To be able to ascertain the cost of this privilege I have issued tickets

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for these free riding facilities. Some people might say, why issue a ticket when the military men are in uniform? My answer to that is that the tramways department have a perfect right to know the actual cost of a concession of this kind; and, again, I am very strict upon the question that each and every person riding upon a tramcar should be a ticket-bearing passenger. In the majority of towns the tramways revenue has fallen very much below that of normal times, and this, coupled with the concessions granted, hits tramways rather hard. On the other hand, certain undertakings have benefitted during "Pastimes" by reason of the public not travelling far from their homes on account of economy and the curtailment of railway excursions generally.

The military order with regard to reduced car lighting, owing to anticipated air raids, was another means of reducing tramcar revenue. Happily this restriction has either been withdrawn or modified; but at the same time we must be prepared for undertakings to be shut down direct from the power-house upon the alarm that aircraft is in the vicinity. I am informed that at Hull this order was well carried out.

In closing my paper, I would thank you for kindly listening to a difficult subject undertaken by me, but I hope I have made it as pleasant as possible. The chief point left to be dealt with is, to my mind, that of the appointment of a Purchasing Committee for obtaining supplies during this appalling war. As we are here gathered, our thoughts go out in sympathy to all our colleagues and workmen who are doing their bit for our King and country with a determination to put this abominable Prussian militarism in the background so that it may never lift its head again. May the name of the Kaiser be handed down to posterity as a re-incarnated, prehistoric barbarian.

DISCUSSION.

The CHAIRMAN: It does seem unfair to make Mr. Dugdale curtail the reading of his paper, but time did not permit of any other course. I hope that anyone who wishes to speak on the paper will be very brief.

Mr. DUGDALE: Since my paper was written I believe that Mr. Fell has been consulted by the War Office, and that Mr. Spencer, the secretary of the Municipal Tramways Association, has become Transport Officer at Bradford.

Alderman H. LINSLEY (chairman of Salford Corporation Tramways Committee and president of the Municipal Tramways Association): I think there is one point which Mr. Dugdale should have explained. A good many members cannot understand the price of the rails given here. Does it refer to tramway rails or to railway rails?

Mr. DUGDALE: I think it refers both to tramway rails and railway rails. The prices of £4 5s. and £3 15s. are for railway rails.

Mr. C. D. STANLEY (engineer and manager, New St. Helens and District Tramways): If Mr. Dugdale can get steel tires at 50 per cent. increase at present he is lucky. Personally, I cannot get them at all—I cannot get an order accepted for them, and that, I think, is the point—not what you have to give for them, but whether you can get them. On the matter of leaving other repairs to the track as a measure of economy, I doubt it very much. As I said previously, high speeds are bad things for car maintenance, but one thing unfortunately is worse than that, i.e., a bad track. A bad track will destroy your cars quicker than anything else. A mile or two of my track at St. Helens at the present time resembles a dried up river bed, and I speak feelingly on the subject. With regard to the munitions business, about which Mr. Spencer was speaking just now, I am very glad to hear that that matter is being taken up. But of course I take it that any recognition that is given will be given to men working, not only to carry munition workers, but also to carry men in subsidiary industries, which are primarily necessary; I mean, of course, such things as collieries. I know that in Lancashire—I do not know whether it is so elsewhere—the distances which the men live from their work are very great, four, five and six miles is not uncommon, and if they are to be kept going the men must be conveyed to and from their work. (Hear, hear.)

Mr. H. P. CONIBEAR (secretary, Lancashire United Tramways): I should just like to call attention to Mr. Dugdale's remarks on the amount which is being paid to dependents of men who have joined the forces. He indicates the process he would like, which seems to go back on the principle of municipal trading. The idea of a municipal tramway undertaking is that it should stand on its own bottom, that it should show its profit as an ordinary commercial undertaking, without depending on any other department. Now, Mr. Dugdale says that the amount paid to dependents should in some way fall equally on all the departments of the Corporation's undertakings. I think the tramway undertaking should bear the whole of the amount itself, otherwise it is going back on the principle of municipal trading, which is that each department should bear its profits and losses I do not think it should be spread over other departments.

Mr. A. V. MASON (general manager of the South Metropolitan Electric Tramways): May I say one word on the dependent question? The British Electrical Federation have it on record that every employee will donate a certain sum to the fund. Whatever the men give, the company gives. Every man gives in proportion to his wages, viz., 1½ per cent., and we have 100 per cent. of the men making those contributions. I think it is a very great satisfaction to the staff generally to know that they are helping in a small way. The men tell me they appreciate the fact that they are helping the wives and families of their colleagues and that they have not got to call on the rates.

Mr. C. G. TEGETMEIER (British Electrical Federation): On the subject of the relief of dependents, I may perhaps be allowed to supplement the remarks of Mr. Mason by explaining the method adopted by the Federated Companies of the British Electrical Federation, outside the T.O.T., the London group. The fund is contributed to by the company and by the men; the men contribute what they like, and the company contribute at least an equal amount. The basis of the administration of the fund is that the dependents of every man who goes to the war shall be maintained in the same circumstances as they were in when the man was working for the company. The scale of grants which Mr. Dugdale referred to as prevailing at Oldham seems inequitable and reactionary. A wife with three or four children will probably get from the War Office as much income as she was getting when the man was at work. If the Oldham Corporation, in addition to that, give the wife of a man who has gone to the front the man's half pay, she is very much better off than when the man was at work. It appears to me that there will be considerable difficulty when the man comes back and the wife and dependent family have to go back to the old scale of living.

Mr. E. H. EDWARDES (general manager, Lancashire United Tramways): I should like to say a few words in reference to the paragraph as to the engineering repair shops being used for the manufacture of munitions. Mr. Dugdale mentions that he is of the opinion that only the large repair shops could undertake such work. That is true, so far as regards carrying out the work on a large scale; but I think it would be very useful if small shops, with three or four lathes, could also start this work. In the first place, they could turn out a certain quantity of munitions, and, secondly, engage many mechanics on part time who cannot be released from such businesses as mills. In Lancashire all cotton mills have two or more skilled turners, but it is not practicable to release these men without stopping the mills, which would mean throwing out of employment thousands of hands. The men referred to are, however, quite able and willing to work overtime and during week-ends on munitions. By adopting this course, not only is a certain amount of useful work done, but the mechanics are kept together, which, as several speakers have mentioned to-day, is essential to tramway concerns, for if the men leave the tramway systems will have to cease running. One other matter Mr. Dugdale touches upon is the question of dependents. I consider that it is to be regretted that some of the Associations have not found it possible to fix some standard rate as to the amount to be paid to the dependents of tramway employees. We all seem to be paying different scales, and in a district like mine, surrounded by wealthy municipal undertakings, I find these authorities, in nearly every instance, pay to the wives or dependents of married or single employees who have enlisted a certain sum per week, which, together with allotment of pay and separation allowance, makes up the amount of wages earned by each man before he joined the colours. The wages of a single driver average from 30s. to 35s. per week. When he joins the army he is paid 7s. or upwards per week from the Government, and his pound or so from his employers is banked for him during the time he is away, so that when he returns in a year or two, or three years, as the case may be, he will have £150 or £200 standing to his credit. I am sure we should all like to act in a similar manner to our employees, as it seems very hard on a driver from one undertaking, who might be fighting next to a man from a wealthy Corporation, to learn that whereas he is getting nothing, his comrade is getting a lot. It appears desirable, therefore, that some standard should be fixed whereby we all pay something, so that the men could feel that they were all more or less on an equal footing.

Mr. W. ROBSON (general manager, Southampton Corporation Tramways): The subject of war dependents and war allowances is a sore point with many of us. When the war broke out, many tramway committees lost their heads and proceeded to pile expenses on to their respective undertakings, whereas if they had more carefully considered the matter, no doubt they would not have done so. I will not mention cases, but there has been quite unnecessary generosity. The chief point of the paper is not the question of dependents' alowances, as to my mind we have gone too far now and it cannot be altered, but I think that many of us would be very glad to hear something about the delivery and supply of materials. This is going to be an extremely serious question, and if any gentleman has any information on that point, I think some of us would be glad to have it.

The CHAIRMAN: The point seems to have arisen on this paper about the provision of badges for the men. The Council of the Association considered this question yesterday, and did not come to any decision as to whether we should approach the Government and ask for badges for motormen and conductors. But we did decide—and I will leave the other question more or less open to this congress—to ask for badges for our skilled men and for the

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power station attendants. I think these latter are absolutely essential to our undertakings and should be exempt from any military service or from munition work. The tramways are essential to carry the workers on munitions; and our skilled men and power station attendants are absolutely essential to our tramway undertakings. Most of you are similarly situated to myself. I have five power stations and I employed naval reserve men before the war, consequently more than 50 per cent. of my sub-station attendants left on the first day after the declaration of war. Since then we have been obliged to do the best we can; the men work in 12 hour shifts instead of eight hour shifts. If the men are going to leave in the future as they have done in the past, it only means the job will have to be shut down. I will ask Mr. Devonshire, who has been in close touch with the Government Departments, to address the congress.

GOVERNMENT AND PUBLIC UTILITY SERVICES.

Mr. JAMES DEVONSHIRE (managing director of the Metropolitan and the London United Tramways): I entirely agree with what Mr. Spencer and the chairman have stated. It has become a very serious and a most anxious question, and if the men go at a very much faster rate than they have been going, we shall have to shut down our undertakings. The question therefore is how to keep the men we have got, and at the same time satisfy them that they are serving their country. I think the probable solution is something of this kind:—You get the men to enrol themselves, on the special forms which have been provided, as munition workers. The forms will then go to the managers of the undertakings, and they will procure a rubber stamp and stamp each form with these words, "Public Utility Service." I am glad to tell you that we have been able to arrange in London with the Ministry of Munitions that if this is done these men will be regarded as sacrosanct to that particular undertaking. But there is another question. As loyal citizens we are anxious to give the Ministry the best possible service with regard to our workshops, and you may be interested to know what we have done in two large undertakings in London. The two undertakings are not physically connected, and as you know, gentlemen, it is very much easier to deal with repairs if you can bring cars from one undertaking to another over the rails. Therefore we approached the Board of Trade and we asked them to use their good offices with a particular local authority. The Board of Trade took the matter up, warmly appreciating the point, and they wrote to the authority concerned, and I am glad to tell you that the local authority have had a special meeting and passed a resolution agreeing to this track being laid down. Now, this will enable us in a few weeks' time to utilise the resources of certain shops to the best advantage of the Government. Now, a word on the subject of badges. We hope to agree, indeed I have agreed verbally, but I hope to get it confirmed in writing, that all the skilled men and power station attendants who are employed for the tramways, such as those on these metropolitan systems to which I have referred, though they may not actually handle munitions at all, are to be regarded just as much munition workers as the men employed at the shops which we are adapting for munition work. They are all to be given a certificate of enrolment and a badge, which will satisfy them and content them, and, I hope, keep them to their work. I thought the congress would like to hear this explanation of the position. (Applause.)

Mr. A. W. A. CHIVERS (British Electric Traction Company): There is one point I should like to refer to, viz., the question of labour on tramways during the war. I should like to hear some particulars on the question of female labour. On many of our undertakings, and also on many municipal undertakings, the shortage of conductors has been made up to a considerable extent by the employment of girls and women. We have found that women make excellent conductors, but in some cases where we have endeavoured to introduce females some of the men have resented their introduction considerably, in one or two particular cases to such an extent that rather than create any dissension among the men we decided to drop the proposal and make the best of matters. Our services at that time had been very considerably reduced, and in order to enable us to run as many cars as possible, we introduced boy labour. That has helped us over our troubles to some extent, but we are still faced with very considerable difficulty in getting a sufficient number of conductors. One of the contentions of the men has been that where women have been introduced it has been at a lower rate of pay. We have not done that; we have always given them the same rate of pay, although their hours are shorter in some cases. If something could be done to introduce more female labour and extend their services to car washing, cleaning, and other comparatively light work, it might help us through some of our difficulties arising from the shortage of men.

The CHAIRMAN: I think the Council of the Association would like to have the sense of the congress on the question of exemption, and also on our proposal that the exemption should only apply to power-stations and to sub-stations, and to skilled workers engaged on tramways, and not to motormen and conductors. The Council think that if we ask for too much we shall get nothing; but it is essential that skilled workers, and the men in the sub-stations and power-stations, should be exempt, and that we should also ask for badges for them. Does that meet the opinion of this congress? Will you show your pleasure that the Council should make an effort to get that concession? I do not think any further debate is necessary; we know the feeling of the Council in this matter.

Alderman J. H. RODGERS (chairman, Newcastle-on-Tyne Corporation Tramways Committee): I object entirely to the linking in of the motormen and conductors on this badge question. We have had that question before us in Newcastle, and it was on those grounds that they took us to arbitration with reference to the war bonus. We laid it down, the committee laid it down too, and the authorities also, that they were not directly interested as munition workers. It would be very foolish if we now say that they are. The only way in which they claim to be interested as munition workers is by the fact that they have to run the workmen's cars to take workmen to the factories, which is a very essential thing. But there again we do not say that that constitutes them munition workers, because we have appealed in Newcastle to the business men to come forward to assist in running the cars. We have business men training now, and our own clerks are training, in order to assist in running cars for munition workers, and in that way we are coping with the very great pressure of the early morning traffic. You will understand what that pressure is when I tell you that there are some 50,000 or 60,000 workmen to carry every morning, which we could not possibly do even if we had every car out that we possess. The train service does not help us, and so some workmen have to walk all the way to their work. I do feel that if you agree that motormen and conductors are indeed munition workers, then the companies and Corporations will suffer by and bye. The men will not forget it in the questions we shall want to settle up when the war bonus stops. The engineers and skilled men, who are only a few comparatively, are most essential to us; those we ought to retain, and we ought to urge that they must rank the same as the men in the Armstrong factories who make munitions. We have had the same difficulties in Newcastle as you have had all round so far as the men are concerned. We went to the Munitions Committee in Newcastle and asked them to prevent as far as possible our men being recruited into the different factories. In fact, we said if our numbers were further reduced we should have to stop the undertaking altogether. Captain Ross, the head of that Munitions Committee, sent us a letter which has been placed in our works, and he has also undertaken to supply our men with the button so as to put them on a safe footing, but I do object to motormen and conductors also being classed as munition workers.

The CHAIRMAN: Well, I trust I made myself plain. I am supported by Alderman Rodgers, and I ask whether we are to try to secure exemption for the skilled men, excluding the motormen and conductors.

The Congress signified its unanimous approval.

The CHAIRMAN: Then we will take action accordingly at once. Now I will ask you to pass a hearty vote of thanks to Mr. Dugdale, and he, like Mr. Mason, must reply in writing.

The vote of thanks was accorded by acclamation.

Mr. DUGDALE'S REPLY.

In reply to Mr. C. D. Stanley I would say that the track renewals are not being proceeded with. At the same time, if it was found that for safety a set of points required renewing, such work, and any other work which was in a dangerous condition, would be attended to. My chief point was the price of rails for immediate track renewals.

Mr. Tegetmeier and the question of payments.—I do not quite agree with him that the army pay should be added to by the employers in such a manner that the men would be receiving the same amount of pay as when working. I consider that the man who goes to fight should be treated generously. Of course, one does hear and know of cases where the wives of our men, and other men, do not take care of the money paid to them, and who spend it far too recklessly. There are again others who do put it away for the dark days which may come. The man who voluntarily offers to fight in this great, bloody, and damnable war is a brave man, and a hero in the true sense of the word.

I am rather surprised that Mr. Conibear should differ with me upon the pooling system of payments. Such an arrangement would be much better. For instance, should there be seven departments belonging to a corporation, and four of the departments send a very small percentage of men to the war, and the other three a very large percentage, it is not at all fair to the three to bear such a heavy cost, and the four get off very lightly.

Mr. Mason's system of making weekly collections from the men to send out comforts to those men who have gone from his department is very commendable. The men of my department, from the commencement of the war, agreed to pay from 2d. to 6d. per week (in accordance with the scale of wages they receive), and this is deducted from their wages. The amount of the collection works out at about 2¾d. to 3d. per man per week.

Mr. Edwardes is doing a very commendable thing in making munitions at his workshops, and his idea of procuring volunteers for evenings, Saturday afternoons, and Sundays is very creditable. I quite agree that there is a large field for such work as he has inaugurated.

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BATTERY VEHICLES AS AN ADJUNCT TO TRAMWAYS.

By W. H. L. Watson.

To deliver a paper upon this subject to the Tramways and Light Railways Association demands not only considerable boldness, but unlimited faith in the future performance of these vehicles; for it must be admitted that in few other fields has so much failure overcome previous efforts. The writer's experience during the past three years with many types of battery vehicles has been so satisfactory that he feels justified in an endeavour to direct the attention of tramway authorities to the virtue of this method of propulsion. The past difficulty has been to provide a means of storing electricity, which would not only be of a robust character, but capable of receiving and discharging its energy with suitable rapidity without strain. The early endeavours to produce an accumulator with these qualities were unsuccessful owing to the materials which engineers then employed. Those put into service were solely of the lead-acid type, which, owing to its great weight and inability to withstand not only high rates of charge and discharge, but vibration, soon proved commercially unsound. Briefly reviewing the batteries now available, we still have the original flat-plate battery, for which the makers claim great improvement in their method of formation. We also have a new type of lead battery, called the Ironclad-Exide, which differs in many respects from the older type, and which the writer believes to be the best of lead accumulators. Both of these types of batteries have the inherent troubles of all lead accumulators, but by careful maintenance and strict adherence to the manufacturers' instructions a good case can be made in their favour for certain classes of work. Another type of battery which is finding much favour in this country is the Edison nickel-iron cell, the introduction of which has opened to the battery vehicle a sphere of usefulness in which no other battery can successfully compete. This accumulator has the advantage of being built throughout of nickel and steel. It is a non-acid battery, the electrolyte being a solution of potash and lithium. The time available will not permit me to detail the differences of the three batteries named, beyond showing in mileage and money the performance to be expected with each type. The following table will show the desired information, and it will be for those interested to decide whether it is better to pay a smaller initial cost with a heavy maintenance charge or a heavier sum with a proportionate saving in these later expenses: —

Comparison between Three Different Types of Batteries of 150-165 Ampere Hour Capacity.

150 A.H. Flat-plate ... ... 11-12 K.W.H. ...	...	List price, £85
150 A.H. Iron-exide battery ... 11-12 K.W.H. ...	...	„ „ £150
150 A.H. Edison nickel iron ... 11-12 K.W.H. ...	...	„ „ £216

Total Cost of Operation over 60,000 Miles' Service.

	Lead.	Iron-exide.	Edison.
Guaranteed mileage	nil.	18,000 to 20,000	60,000
Plate maintenance	1¼d. per mile	—	—
Fair mileage to expect	6,000	20,000	150,000
Original cost	£85	£150	£216
Plate maintenance for 54,000 miles at 1¼d. ...	£337 10s.	-	—
Renewal of plates at 70 per cent. of original cost (£105) × 2, representing 40,000 miles ...	—	£210	—
Plate maintenance	—	-	nil.
Total cost of battery at completion of 60,000 miles	£422 10s.	£360	£216

Having indicated the comparative costs of the battery and its maintenance for an output of 150/165 ampere hours, which can be regarded as a ratio for other capacities, I will now describe the special instances where battery-driven vehicles can make success.

In towns such as Morecambe, Lancashire, where the conduit system of tramways is barred owing to the possibility of interference of service by incursion of the sea, not to mention the high cost of such an installation, and where the overhead system is regarded as a menace to the scenic surroundings, the battery tram will be of great service. Horse trams have operated successfully for many years. With the advance of time electric traction has been seriously discussed, with the result that a scheme for installing battery-driven cars was considered, whereby a capital expenditure of, approximately, £18,000 was involved for the installation of twelve fifty-six-passenger, double-deck cars, and the necessary depot complete with charging equipment and the extension of mains. The running costs were guaranteed not to exceed 5¼d. per car-mile, covering write-off of capital, labour, and all running charges. If this installation is made it will be the first of its kind in this country, but there are existing tramways working on this principle in the United States. It is interesting to note that battery rail cars, capable of carrying 40 passengers with a total weight of 15 tons, average a current consumption of 600 watt hours per car-mile; maximum speed, 30 miles per hour; miles per charge of battery, 100.

The battery omnibus will probably prove to be the more popular method of building up routes, prior to the extension of a full tramway service, owing to its cheaper installation and greater mobility. These 'buses are already installed in Southend, South Shields, York, West Bromwich, and Loughborough. In the first three instances the results have been very gratifying, the vehicles not only having given a highly satisfactory service, but the low running costs expected have been proved conclusively. At Southend-on-Sea, where one battery-driven 'bus was installed to run on equal terms with a fleet of petrol and petrol-electric 'buses, a saving of 2d. per mile plus halfpenny profit to the electricity department, making a net saving of 2½d. per mile, has been shown in favour of the battery vehicle.

At South Shields I find that the current consumption per mile varies between 1·03 and 2·10 units, the variation being specially noticeable owing to the road surface conditions encountered and variable weather. The maintenance charges have proved very slight, and with such low average weekly revenue as 5·92d. the service covers expenses. At York Mr. Hame announces that the four Edison 'buses have run 13,600 miles with an overall energy consumption of 1·1 units per mile. The instalment of 'buses at West Bromwich and Loughborough has only recently been made, consequently running costs are not yet available. They will be of special interest, as they are to cover routes previously occupied by petrol-driven chassis.

The ideal method of employing these vehicles is to fix a terminus at which point the vehicle awaits passengers for a few minutes. Here current can be taken at a high rate of input, the time taken to replace sufficient current (at six times the normal rate) to cover one mile of even road surface being one and a half minutes. Therefore a stay of four and a half minutes will in many cases replace sufficient current to cover the major part of a journey. At Southend-on-Sea it is no infrequent occurrence for the battery 'bus to return to its garage at night with no more than 40 ampere hours used out of a total capacity of 300 ampere hours after a day's journey of 100 miles. Where "boosting" facilities cannot be arranged, a larger size battery may be necessary; but a mileage per day of 45 to 50 miles could easily be accomplished, providing the district is not of an extremely hilly nature. Upon hills the vehicle proceeds at a reduced pace, and where considerable gradients are met this is sometimes reduced to a little more than a crawl. It should be appreciated, however, that it is possible to run 'buses under these conditions at a running cost which will render light services profitable, or at least self-supporting, whereas either petrol or petrol-electric 'buses would prove uncommercial. The writer is of opinion that many omnibus proprietors, and, for the matter of that, taxicab owners, have educated their customers to expect too great a speed, which at the present revenue rates must prove unprofitable. Had their businesses been developed more on the lines of comfort there would have been fewer failures. It must not be assumed that the battery vehicle is incapable of speed; speed can be accelerated provided the current supply is in proportion to the distance to be traversed. The "electric" has been developed to travel at a useful speed under the most economic conditions. It is a peculiarity of the vehicle that when under way it appears to be journeying at a much slower speed than the mileage really registered. Including stops it has been found capable of averaging a speed of 7½ miles per hour. This compares very favourably with the London 'bus, whose average rate of travel is approximately eight miles per hour. For country service high speed is not essential. When it is remembered that the passengers have been accustomed to traverse the same routes under very varying conditions in the past this will be better appreciated. It seems unwise to develop a new route under speed conditions, which can only result in a short life owing to the high running costs. The promoters simply whet the appetite of their customers, and when ultimately the service is discontinued leave them in a worse plight than they were prior to the installation being made. The service will be much better appreciated if it is run upon conditions which the route can afford, thereby ensuring permanency.

Where the district is so scattered that a vehicle becomes a matter of necessity to the manager when doing his round of inspection, an electric roadster or coupe seems an ideal car to suit his purpose. Such a car has been in the service of Mr. A. C. Cramb, borough electrical engineer of Croydon, which does an average service of 24 miles per day. He gives the following interesting figures as to the cost of operation, the debit for tires being based upon the assumption that an average of 5,000 miles will be obtained before they require renewing, there being ample justification for this assumption in view of the very small wear so far observed: —

Running Costs.	Total Cost.	Pence per mile.
Electric energy at 1d. per unit	£4 11 8	0·510
Oil and grease	0 1 5	0·007
Tires (£35 per set for 5,000 miles)	15 0 0	1·660
Washing, cleaning, &c.	3 10 0	0·388
Total running costs		2·565d.
Depreciation.		
Battery (5 years)	£14 8 4	1·600
Vehicle (10 years)	14 13 4	1·620
Total fixed charges		3·220d.

Total cost per mile = 5·785d.

In this case the mileage is somewhat low, but where the mileage is increased to, say, 10,000 miles per annum, the total cost per mile would be reduced to 4·175 pence. It will be seen that Mr. Cramb has only given the battery credit for a life of five years, which in total amounts to 36,000 miles; whereas under more stringent conditions the suppliers of the battery guarantee full-rated capacity

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at the completion of 60,000 miles, which, under these conditions, cover at least ten years' service. But for the condition of the country during the past year a new vehicle would have been placed upon the market suited for the conveyance of members of the staff on their duties. This vehicle is designed on very light lines similar to the petrol-cycle cars, which have become so popular. It is believed that such a vehicle would find much favour as a means of conveying inspectors, also for the collection of coppers, distribution of tickets, etc., etc. This vehicle it is hoped will not exceed a cost of £300. Upon a similar chassis will be mounted a trade body of the box variety. This has been specially designed for the use of tramways departments in connection with their parcel delivery service. Here, again, low price has been given the utmost consideration - initial cost will be approximately £270. So great will be the advantage of such a vehicle to parcel delivery services that it seems likely a number will be employed once the low running costs have been suitably demonstrated. Assuming that an average mileage of 30 miles per day is accomplished, during 300 days per annum, and current can be obtained at 1d. per unit, including current, maintenance, tires, insurance, depreciation (seven years), and interest at an average rate of 5 per cent., the total running costs will not exceed 2¼d. per mile.

The tramway departments of Ilford, Derby, and Belfast employ battery-driven tower wagons, each of which amply satisfies their requirements. These vehicles have a speed of from 11 to 12 miles per hour, which is generally found sufficient for the traffic to be negotiated. When out of service the opportunity is seized to revive the battery. The mileage available per charge is from 40 to 45 miles, which has proved more than sufficient for a day's work. As an illustration of the benefit of these vehicles, the following extract from an article written by Mr. L. E. Harvey,* tramways manager to the Ilford Urban District Council, whose Edison electric tower wagon has now been in service for twelve months, is interesting :—

"This tower wagon, designed by Mr. Harvey, was purchased on the basis of tenders, which showed lower all-round costs in comparison with petrol and steam vehicles. In actual practice the electric vehicle has improved upon the estimates. The running costs are very low, being only a little over one unit per mile, although the wagon weighs about three tons when loaded with its equipment of tools. Maintenance costs have been zero, except for a little distilled water at intervals to make up for evaporation. The vehicle is, in fact, running better than ever. So far there is no sign of wear on the tires. Any ordinary workman can drive the vehicle. Several of the depot hands are licensed, so that there is not a moment's delay in getting the vehicle out on repair work. The absence of a bonnet enables the vehicle to be driven close up to the pole where repairs have to be carried out. With petrol wagons manœuvring backwards and forwards had always to be done to get the platform in position. For pole to pole inspection the electric vehicle is a great time-saver. Another advantage is that electric light is available. Flare lamps are exceedingly troublesome in windy weather, and are at all times less convenient than the cluster of electric lamps, which can be hung on the wires or fixed to the rail of the platform. Everything being electrical, any repair work can be carried out by the depot staff. There is no need to have men specially acquainted with petrol engines; neither is there any nuisance with storing petrol."

Supplementing Mr. Harvey's statement, the battery will provide current for operating electric drills, saws, and riveters for bonding, and any other small tools in which either power or heat are required. It will be easily realised the immense advantage to the testing engineer to have a large capacity battery at 70 volts available at any section or feeder pillar for testing purposes during times when the network is dead.

For maintenance of the track and road repairs a vehicle of two or three tons carrying capacity would be of great general utility. For carrying materials such as pillars, setts, and other weighty equipment required on permanent tracks or extensions this vehicle will do all that is required, and by provision of an interchangeable tank body of 500 gallons capacity a further field of usefulness will be provided for watering at any time when current is not available. This same vehicle has been utilised for carrying and drawing in cables into the ducts. It may sometimes be found useful for removing cars from a section where a breakdown has occurred, thus releasing the vehicle to proceed with its curtailed journey.

In conclusion, I would suggest that your own experience, coupled with a knowledge of local conditions, may discover applications of battery vehicles which have escaped my notice. I shall therefore be pleased to hear opinions on this subject, and shall welcome any suggestions that may enhance the value of "battery vehicles as an adjunct to tramways."

DISCUSSION.

Mr. W. Robson (general manager, Southampton Corporation Tramways): About a year ago at South Shields we tried two battery vehicles, and I must say that during the time I had to control them our experience was very satisfactory indeed. There are one or two points in Mr. Watson's paper that I would like to criticise. One is on the question of speed up steep gradients. We found when we had a gradient of 1 in 6 or 1 in 8—a very steep hill, the omnibus went up at a speed equal to that of the petrol omnibus, but when we had a long, slow gradient—say, 1 in 20—the passengers began to make sarcastic remarks about getting out and pushing. No doubt the electric vehicle pulls slow on a long gradient, and that to my mind is a thing which will have to be altered before the battery omnibus can become popular. In a flat country as, for instance, in places like York—where they run now—one could not have anything nicer, and the speed is quite fast enough. The vehicle goes along at 11 or 12 miles an hour on the level, with very satisfactory results. We find the passengers who use them like them very much indeed. The freedom from smell and the absence of noise make them popular; in fact, passengers prefer them to tramcars. We had no trouble at all with maintenance work; the omnibuses used to go out in the morning, come back at night, and one did not think anything more about them than if they were tramcars. At night time the handy men in the sheds used to put them on charge, and by a system of numbered switches, 1, 2, 3, 4, and so on, an absolutely unskilled man was able to charge them without any bad results. We did not engage any other men for these omnibuses, but simply used our own staff. Reliable motormen were taken off to drive them. They were one-man vehicles, and we did away with the conductor, and so reduced the running cost in that respect. The boosting was also carried out by the motormen without any trouble by means of these numbered switches. We found the only maintenance necessary was the cleaning up of the controller contacts and the filling up of the batteries with distilled water about twice a week. We were never worried about the motors the whole ten months I had control of these vehicles; we never had to clean a commutator. No doubt the design of these vehicles is very good indeed. It is only the point of speed which I think will always be against them for omnibus traffic in anything like a hilly district. I have wondered if it would not be possible to adopt a form of battery switch which would insert extra cells when going up a gradient. Another matter that Mr. Watson did not touch upon is the initial cost of these vehicles. The cost is very much too high, and I hope it will be very considerably reduced during the next few years. Unless it is, I am afraid the battery omnibus will not take the place of the petrol vehicle as an adjunct to tramway systems.

Mr. L. E. Harvey (general manager, Ilford Corporation Tramways): We have used a tower wagon for 18 months or so, and I can only say that it never gives me a moment's trouble. We not only use it for the repair of overhead wires, but frequently it has been utilised to pull 60 ft. rails about. Yet we have never had any expense in maintenance for it, except of course for the distilled water. We have never had a breakdown or anything of that sort. The vehicle has been altogether satisfactory, and I can recommend it, although the initial cost is high. I should recommend every tramway manager to get one. I am perfectly certain that he will be more than satisfied with it and he will save money in the long run. I have nothing but praise for our tower wagon.

The Chairman: Can you tell us what was the cost of it?

Mr. Harvey: Speaking from memory, £675 complete. The speed is about 10 to 12 miles an hour. I did not ask for a high speed; I do not believe in high speeds for tower wagons. I think 10 or 12 miles an hour is ample speed for a tower wagon, considering the peculiar shape of the vehicle. It has to go round curves and corners, and it carries a lot of tools, &c., on top, which tend to make it top heavy. For such a vehicle, 10 to 12 miles per hour is sufficient speed.

Mr. A. V. Mason: Is that 12 miles per hour downhill or on the level?

Mr. Harvey: Twelve miles on the level.

Mr. Mason: Did we not try one that could not go more than eight miles an hour on a gradient.

Mr. T. B. Goodyer: Yes, Mr. Watson will probably refer to that in making his observations.

Mr. W. Wyld (Hampstead): I did not intend to say anything on this subject, and I am afraid that I cannot say much from a tramway point of view. I have recently had to give my attention to electric vehicles, not as tramcars, but for the removal of dust, refuse, etc. For over a fortnight with an Edison battery vehicle we were able to do for 9s. 6d. what is costing at present by horses 35s., so that on those figures we were saving by getting electric vehicles. We are just now negotiating for the purchase of a vehicle to hire out to the Works Committee for duty. I thank the Council for their kind invitation to be present to-day.

Mr. E. Hatton (Newcastle-on-Tyne): When I read this paper one thought which occurred to me was that the disadvantages of the petrol omnibus were done away with. Now, of course, we see that these vehicles have certain difficulties. There is no doubt, however, that the electric vehicle has a great many uses. Many people when electricity first came into vogue said the gas industry would be destroyed, but that has not happened. So with this vehicle, for which there is a big field, for odd jobs and so on.

The Chairman: We are very sorry that the discussion has been so short. In ordinary times, and not war time, there would have been a big fight between petrol advocates and battery advocates. Nevertheless, we are much obliged to Mr. Watson for his paper, and I propose that we give him a hearty vote of thanks.

The vote of thanks was accorded by acclamation.

* *Vide* The Tramway and Railway World.

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Mr. W. H. L. Watson: Mr. Robson mentioned the speed of vehicles on slight gradients; we have been making some experiments in order to overcome this difficulty by having change speed gear. I must say that so far those experiments have not been very successful. Maybe when we experiment further we shall get a better result; the result of the experiments was not to increase the speed at all but to get a lower current consumption on hills. I quite agree with Mr. Robson that when put on substantial gradients the electric omnibus has a speed equal to the petrol omnibus, provided there is no opportunity of the vehicle getting a rush at the hill. At Southend, facing the pier, there is a short hill, about 350 yards, and it is a fact that the petrol omnibuses in service there were not allowed to stop on that hill. If by chance they did stop, they immediately began to roll back and had to make another go at it; but that was never the case with the electric vehicle. This would stop and take up passengers on the hill and equal the speed in every case of the petrol electric or the petrol omnibus. With regard to the suggested arrangement for some kind of switch to bring in more cells under those conditions, there is no difficulty in the way of doing that so far as the use is concerned, but there is a disadvantage when you come to charge the batteries, because the batteries will not be equally discharged, and that would interfere with the proper charging of the end cells. With regard to the cost, we regret the cost just as much as the buyers. I can assure you in our efforts to get vehicles into service we do a lot of work which results in failure owing to the high price. Some purchasers state they would rather go without than pay the price, but those who do pay the price do not seem to be dissatisfied. We have fleets of vehicles numbering 50, and those vehicles are in the service of people who if anything are keener buyers than those associated with tramway concerns. I refer to such firms as Messrs. Harrod's, Messrs. J. Lyons, and the Midland Railway Company, all of whom were very difficult to satisfy when we endeavoured to get their custom, but having made the test they were satisfied that the average running speed of the electric vehicle was suitable for their purposes. It is no part of my policy to encourage you to employ battery omnibuses or any other vehicle driven by means of batteries from which we ourselves are not confident that you will get sufficient success. At the present time I have just returned from Halifax, and I daresay a good many of you know that that town is not the nicest place in the world in which to run omnibuses; apart from the hills the roads are bad. I cannot say I have been pressed to take an order, but the officials have pressed us to submit a scheme. I did not say I would or would not, but I have discussed the suggestion to-day with my managing director, and we have decided that it is impossible to make an offer there. They have four roads, two very hilly indeed. There are 24 omnibuses running there now, and evidently they are not entirely satisfactory. I have been told that sometimes one vehicle will carry as many as 50 people. But battery omnibus manufacturers could not possibly allow such overcrowding, though it might be possible to do the work there if overcrowding was limited to 34 or 35 passengers. I think that will prove to you that we are not anxious to get business which will result in failure; we are only in business to meet success. Mr. Mason mentioned the subject of tower wagons, and referred to one which we sent to Croydon. It is a very rare occurrence, but unfortunately faults developed suddenly on that vehicle. Some vehicles were shown to those gentlemen at Croydon which two days afterwards were doing 15 miles an hour, and that vehicle possibly was the one that went to Derby. I have seen it since, and they are highly satisfied with it. In fact, they contemplate purchasing some omnibuses from us. With regard to Mr. Hatton's remarks, I think we agreed that our omnibuses were not suitable for the kind of work he required them to do in Newcastle, but I still believe there is an opportunity of doing some business with him in other directions.

The Chairman: I think that closes the congress, with the exception of an announcement. Mr. Robson asked what was being done in regard to supplies. Our chairman stated this morning that the Council had passed a resolution to approach the Minister of Munitions to ask for facilities for the manufacture and delivery of all materials required for tramways, and also facilities for transport. That request will be pressed. Our inquiries have been directed principally to the fast-wearing parts which there is a difficulty in obtaining in this country, e.g., steel tires. We find the position very serious indeed. Comparatively large systems have only a week's or a fortnight's supply of steel tires in stock. We are met on the other hand by some large systems who tell us they do not want our help, as they have plenty of tires on order. But we know the position is serious because those tires on order are not going to be delivered. As an Association we shall have to press home for all we are worth that the Government must grant us facilities for obtaining what is on order, and when the tires are made they must be delivered. We can do no more than that. There is another announcement that I wish to make. It is that any members who have Provisional Orders or Acts authorising tramways, and who require an extension of time owing to war conditions, should communicate with the Association. The Board of Trade have been approached, and we intend to ask them again to pass one Act including all such undertakings, because of the saving of expense and time. If members will give us the particulars of such Acts or Orders, we will try to get them incorporated in the one Bill. I think the Board of Trade will oblige us under the peculiar conditions of the time. We hesitated a long time as to whether a congress should be held this year or not. We have abandoned, like other associations, our formal annual dinner, but it was necessary to hold an annual meeting, so we took the opportunity of calling the congress, and I hope you will all agree to-night, when our informal gathering is over, that the proceedings have been very successful. (Applause.)

Mr. T. B. Goodyer: I am sure the members would not like to leave without passing a very hearty vote of thanks to Mr. Harry England, our vice-chairman, for presiding so ably.

The vote of thanks was heartily agreed to.

The Chairman: I am very much obliged to you. I want to apologise for the absence of Mr. Stephen Sellon, who is far from well or he would have been here. He sends his regards to all old friends.

The congress then terminated.

THE ANNUAL DINNER.

The annual dinner took place in the evening at the Trocadero Restaurant. The Hon. Arthur Stanley presided, and among those present were the following: —

P. S. Allen.
J. G. Ames.
J. F. Baker.
E. S. Barralet.
B. G. Battson.
W. W. Beaumont.
H. R. Beken.
E. Benedict.
W. Bishop.
H. E. Blain.
F. Bland.
J. H. Bowden.
Ald. H. Brown.
—. Browning.
R. C. Bullough.
F. Burtoot.
C. D. Burnet.
S. H. Callow.
J. Mel. Cater.
A. E. Cave.
G. S. Chisholme.
R. Chisnall.
—. Cockshott.
H. P. Conibear.
R. W. T. Corbett.
F. Crookes-Harris.
A. Coveney.
A. de Turckheim.
J. W. Dugdale.
J. Eades.
E. H. Edwardes.
W. Y. Edwards.
H. England.
E. J. Fox.
E. H. Fleming.
W. E. Freir.
J. Fry.
T. E. Gatehouse.
G. Gerrish.
W. Gilbert.
J. Barber Glenn.
T. B. Goodyer.
A. J. Graham.
R. R. Greene.
J. G. Griffin.
J. B. Hamilton.
E. Hatton.
C. W. Hill.
W. T. Hill.
—. Hind.
A. J. Hollington.
—. Howard.
R. J. Howley.
J. Housman.
A. H. Jackson.
—. Kelly.
H. Kerr.
—. Kidner.
—. Kinghorn.
F. H. Lamb.
Ald. H. Lansley.
W. L. Lorkin.
H. Lotery.
Jas. Lotery.
E. H. Manley.
H. Martin.
A. V. Mason.
H. F. Maynard.
Comm. R. Mayne.
—. Mercer.
C. Mittlehausen.
J. F. Moss.
E. A. Nash.
—. Neave.
A. Norton.
W. T. Robson.
Ald. J. H. Rodgers.
C. W. Rooke.
P. Rosling.
F. R. C. Rouse.
—. Rovce.
F. E. Saunders.
H. M. Sayers.
H. Scholey.
E. E. Sharp.
R. T. Simcock.
J. Slattery.
W. A. Smith.
Ald. R. A. Smithson.
H. K. Spark.
—. Spurr.
Hon. A. Stanley.
C. D. Stanley.
A. W. J. Talbot.
W. Thom.
J. B. Tippetts.
A. Toms.
H. E. Townell.
—. Turnell.
W. C. Ullmann.
A. H. Walton.
W. H. L. Watson.
H. L. White.
A. M. Wilcox.
—. Williams.
W. Wyld.
—. York.

The dinner was informal, and there was no prearranged toast list. The chairman, in the course of some remarks which greatly entertained the company, paid a well-deserved compliment to the secretary, Mr. A. de Turckheim, who expressed his thanks, but could not be prevailed upon to make a speech. The chairman subsequently gave an interesting account of the work of the Red Cross, and it was suggested by Mr. J. B. Hamilton that the two Tramway Associations might jointly arrange for a tramway contribution to the Red Cross Society.

REPORT OF THE LIGHT RAILWAYS COMMISSION.

In their eighteenth annual report the Light Railway Commissioners deal with the proceedings of the Commission up to the end of last year. The eight Orders confirmed in 1914 authorise 37 miles of line, at an estimated cost of £305,587. Five new applications made in November last remain to be considered.

Pursuant to Section 3 of the Light Railways Act, 1912, applications made to the Treasury in 1914 for advances under the Development and Road Improvement Funds Act, 1909, in aid of light railways have been sent by the Treasury to the Light Railway Commissioners, in order that they might report thereon to the Development Commissioners. The question arose for consideration whether an advance out of the Development Fund might be available for the construction of light railways as works of public utility for the relief of such unemployment as in the month of August, 1914, was anticipated to be likely to follow the outbreak of war.

The Development Commissioners reported to the Treasury in the case of the North Lindsey Light Railways, and recommended that a loan of £60,000 should be made out of the Development Fund. By the end of October, 1914, however, it did not appear that the advance of money out of the Development Fund for the purposes above-mentioned would be likely to effect any measure of relief which was immediately pressing; in these circumstances, and in view of legal difficulties, the Treasury decided that an advance should not be made to the Lindsey County Council for the purpose of transfer to the Great Central Railway Company. Having regard to this decision, the Development Commission did not proceed with the consideration of an advance through the Staffordshire County Council to the North Staffordshire Railway Company in aid of the Trentham, Newcastle, and Silverdale line.

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RAIL CORRUGATION AND ITS CAUSES.

The papers by Mr. S. P. W. D. Sellon on Rail Corrugations, and by Mr. W. Willox on Rail Steels for Electric Railways, with the discussions thereon, at the Institution of Civil Engineers, occupied three evenings a year ago. The official *précis* of them was given in these pages at the time, but no report of the discussions was then permissible. This appeared for the first time in April and in the Volume of the Proceedings of the Institution for December. About forty members took part, all of whom spoke with knowledge of the subjects, which, as the chairman at the first meeting, Mr. John Strain, truly observed were not a little speculative. It is not proposed in these extracts to go into the questions raised in the paper by Mr. Willox, except so far as they affect the corrugation of rails on tramway lines as differing from the "battering" found on the underground lines and elsewhere.

Mr. A. J. Lawson considered that one of the chief causes of corrugation was the fact that no two motors possessed the same characteristics, so that, if put on the same bogies or on the same cars, one would try to get ahead of another in point of speed.

Mr. John A. F. Aspinall, General Manager of the Lancashire and Yorkshire Railway, thought it would be generally agreed that nearly all the trouble had arisen since it became necessary for other reasons to have multiple-unit passenger trains, so that passengers could get from one end of the train to the other, carrying with it the necessity of placing all the machinery below the floor of the car, so that the centre of gravity was a great deal too low, coupled with the fact that very small wheels were used. Corrugation had shown itself in tramways all over the country. What was used on tramway rails was practically a grinding machine called a tramcar which collected the dust of the road for the purpose of grinding away the rail. Any engineer who had workshop experience knew that if he had a grinding machine which was intended, say, for grinding slide bars, unless some arrangement was used whereby the emery wheel was made to traverse sideways at the same time that the bar was travelling underneath it, so as to get a fresh path for the emery wheel every time it advanced or receded, corrugations were formed on the slide bars, and it was impossible to stop them from being so formed. But once the grinding machine was made with some reciprocating motion at the side, which caused the emery wheel to change its path every time, those corrugations disappeared, and a perfect surface was obtained, which looked as a ground surface should be—absolutely level throughout. He ventured to say that a tramcar was about the worst grinding machine in existence, and that the corrugations must be put down to the combination he spoke of—the small wheel, the low centre of gravity, and the collection of dust which took the place of emery.

Mr. A. L. C. Fell, Chief Officer, London County Council Tramways, was disappointed to find that many of the causes of corrugations were still traced to theories which had been investigated for many years without any apparent progress being made. About six or seven years ago a committee was formed to investigate the whole subject of rail-corrugation. The committee went to work for a considerable time, but it could not arrive at any definite result. The committee was then divided into sections, each of which was told off to investigate a particular portion of the subject. Those investigations were still proceeding. The line of each investigation was that the sub-committee was trying to eliminate all the theories which had been put forward, and by that process of elimination it was hoped some day to arrive at the real cause. What was really required was a competent board of experts who would devote their whole time to the subject and advise the committee; unless they could do so he did not think they would ever put an end to the trouble. Corrugation was a very serious matter. It had been stated that about £10,000 a year was being spent in Glasgow, owing to corrugation. Mr. Fell did not know how that £10,000 had been arrived at; he presumed the rails must have been allowed to get into a very bad state before the engineer started to rub out the corrugations. In London it cost the London County Council more than £2,000 per annum, and he calculated that about 13 tons of rail were lost annually in rubbing out. If it were a fact that the steel rail of to-day was neither hard enough nor tough enough to meet the duty imposed upon it by the conditions of electric traction, and that well-made rails containing a high percentage of carbon were practically free from trouble, why were ordinary cast-steel work and manganese-steel special work corrugated? The manganese-steel which was being used contained 1·25 per cent. of carbon, and 13 per cent. of manganese, and had a tensile strength of 60 to 70 tons per square inch, and yet it was badly corrugated. On the question of silicon rails, the London County Council had put down high-silicon rails on many of their worst curves, and also on straight lines. In one case Sandberg rails which were laid on the straight in August, 1913, were found to be corrugated, and on a curve of 600 feet radius the corrugations had to be rubbed out on January 2, 1914. These rails were in a very bad state at the present time, and required rubbing again, so that not much improvement had been found from the installation of them. Sandberg rails or hard rails would probably postpone the evil day when corrugation appeared, but they would not prevent it. It was stated that no corrugation had occurred on 10,000 tons of rails which had been down some time ago in certain provincial towns, although on extensions of those lines, laid more recently, corrugation had appeared. It would be interesting to know whether on those lines the service had been a heavy one, and also the type, section, and weight of the rails in question. He did not quite agree that corrugation was generally visible at an early stage, although that was the case sometimes. For instance, in the subway between Kingsway and the Embankment, corrugations appeared within a few days after the subway was opened. They developed very considerably, but they were not rubbed out in the subway, because that was found to be a very interesting experimental ground for corrugation. It was found in the subway that the corrugations reached a certain pitch of badness, but they got no worse. Another interesting point was that they did not move. Rubbings had been taken at places marked off on the walls of the subway, and it had been found that the peak of the curve did not move along the rail, but always remained practically at the same spot. There were exceptions to this, but they were very few. With regard to rubbing out the corrugations, it was found that although, on the average, corrugations did not appear for a period of one to two years, if the corrugations were rubbed out they came back again in a few months. Corrugation-pitch was generally 2¼ to 2½ inches, and as a rule the grooves which appeared on the various rails were at multiples of those distances. It had been found from many measurements that the wave-lengths were the same on ordinary and on high-silicon rails, and also on manganese and cast-steel special work. The shape of the corrugation varied; it was sometimes at right angles to the rail, sometimes at 45° or even 60 in the direction of the running of the car. One possible explanation of the corrugation was that there appeared to be a much greater tendency to corrugate with a grooved rail than with a bull-headed rail, and that might account for the difference between railway practice and tramway practice. That was the experience obtained in London, were the bull-headed rail had been used in connection with the side-slot system in Kingsland Road, where the corrugation was so slight that it could hardly be seen. Bull-headed rails had been put in the Embankment subway, where all the other rails were corrugated, and it was found that they were less corrugated than the grooved rails. If, as stated, it rarely happened that a whole tramway became corrugated, that tended to disprove the theory that the manufacturer was at fault, because on many miles of the track which had been laid in London since 1906 corrugation had not yet developed sufficiently to make it necessary to rub it out, and yet rails from the same batch laid elsewhere under exactly similar conditions were very badly corrugated. It was another interesting point that some of the rails corrugated only at curves and not on the straight. The actual tensile strength of one of the rails photographed on the screen was 51·9 tons per square inch. That rail had been laid for 13 months, during which the corrugations had been rubbed out twice, in May and in October, 1913, and it was very badly corrugated. That might be accounted for by the fact that the rail had had no less than 826,000 cars over it. Some years ago an experiment was made on the Embankment at a place where corrugation was severe. A badly corrugated rail was taken out and a new rail was inserted, in which saw-cuts had been made at the same distances apart as corrugation waves had occurred on the previous rail, the idea being that if cold rolling took place the saw-cut would be filled. But nothing of the sort happened. The saw-cut became the peak of the corrugation, and nothing happened until the whole corrugation was worn out, and the cut disappeared simply from the wear of the rail, leaving the corrugation behind. In the case of one of the photographs, nature apparently was providing a crack so that the rail could be rolled into it. He would very much like to know if it had been possible to measure the depth of that crack in the rail. Apparently what had happened was that the wheels of the cars had rolled the rail until the elastic limit had been reached, and a destructive effect had resulted on the top of the wave. It seemed to him that the same wave formation was obtained whatever kind of car was run. The London County Council had cars ranging from 10 to 16 tons in weight unloaded; they ran at many and variable frequencies; they ran at Board of Trade speeds of 4 to 16 miles per hour; they used steel wheels 28¼ inches to 31¾ inches in diameter, made of steel having a tensile strength ranging from 50 to 70 tons per square inch; and chilled-iron wheels also had been used; but the same wave-formation occurred. They used four-wheeled rigid trucks, four-wheeled radial trucks, and bogie trucks, and the persistence of corrugation under all those variations in conditions strengthened the theory that something was wrong with the rail itself. He thought the only thing that could be done was to form a committee of experts who, in co-operation with the rail manufacturers, would solve the problem.

Mr. W. Worby Beaumont referred to a paper on a cognate subject he had read before the Institution in 1876, and to another before the British Association in 1911. In the latter he had stated: "The reduction of weight is possible, the reduction of speed is possible, the use of larger wheels is possible with future cars, and the use of harder or more resistant rail materials may be possible, but they would have to be produced by methods more costly than

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those now adopted." The interest he had always taken in the subject had been renewed by his appointment as Chairman of the London Joint Committee on Corrugation, appointed by the Tramways and Light Railways Association and the Municipal Tramways Association. He gave an illustration of what was happening on rails with even 0·6 per cent. of carbon. The small wheels of the pony bogies used on electric cars caused much deeper depressions in the rails than those caused by the larger wheels, which most people thought were carrying the greater load, the pressure per unit of area in contact between wheel and rail being much more intense in the case of the small wheels. The pressure, in fact, was beyond the elastic limit of the material of the rail in compression. In climbing the side of the depression in the rail, the wheel tended to roll the material forward, and the tensile strength, the toughness and hardness of the material, were called upon to resist the molecular disruption of the surface of the rail. When the point was reached at which it required less effort to push the wheel over the crest of the elongated depression than it did to roll the material forward, the wheel went over, and the crest of the depression became a hard point. The process was repeated, just as it was in certain rolling processes in steel works, but the material of the rail was held by the mass of the head of the rail and could not be detruded. In tram rails the corrugation often began by the rolling along and pushing of the material at the edge of the groove, especially when it happened that the rail was not at the angle of the tire of the average wheel. Ultimately the corrugation extended right across the rail. There was no other cause for the corrugation than the slight rolling action and the concentrated pressure upon the material of the surface of the rail. In the old days, with iron rails, the pressure was dissipated in the rail by detrusion on both sides, and in the tires by detrusion of the material on the non-flange side of the wheel, and even the pushing over of the flange out of place, and eventual longitudinal cracking of the tire.

Mr. H. T. Wakelam, Engineer and Surveyor, Middlesex County Council, said that many causes of the trouble had been suggested, but, so far, the real cause had not been found. A short time ago the Institution of Municipal and County Engineers sent out seventy-one questions to thirty-five engineers of tramway systems in the United Kingdom, and received no less than 2,350 answers to questions on this subject. But in all those replies there were no data from which any definite conclusion could be drawn, especially as corrugations were found on trolley wires, on lift guides, and on wood pavement.

Mr. W. J. Hadfield reported on the advantage derived from the use of manganese steel on the Sheffield Tramways, and mentioned that one of the disadvantages of corrugated rails was that they loosened the track, caused heavy repairs, and were detrimental to the vehicles. At Barrow, rails containing about 0·4 per cent. of carbon had been used for 9½ years without a sign of corrugation. At the end of that time, as the ends of the rails were becoming battered, they were anchored, an inset plate being introduced in the head at the joint. Immediately that was done corrugation developed very quickly, and persisted until the rails were taken out of the track. That proved to him that it was neither the rails nor the small wheels which were the only causes of the trouble; there must have been a third cause which had introduced corrugation in that particular case. It had been found also, when a long length of rail was taken out of a track and put alongside as a temporary track, that the rails developed corrugation. They could not have been on a more flexible foundation; nevertheless, corrugation occurred, although the rails were previously free from it. If corrugation was due to the smallness of the wheels, why should it not occur in every place where the rails were of the same composition and the wheels were the same size?

Mr. R. B. Holt, Highways and Permanent Way Engineer, of Leeds, considered that the wear of rails on electric tramways was influenced to a considerable extent by the design and construction of the rolling stock. Tramcar wheels varied in diameter to a considerable extent after a very short period of service. In Belfast it was hoped that this particular trouble would be overcome by the introduction of pinions and gears at each end of the motors; whilst at Huddersfield, cars were being equipped with differential gears on each driving-axle, with very satisfactory results. During the past 6 years more than 7,000 tons of Sandberg high-silicon steel rails had been used on the Leeds Tramways, and it was worthy of record that so far there had been no indications of battering and no corrugations had had to be ground from rails of this quality. From actual experience with such rails in Leeds, it was safe to assume that the effective life of the rail would be extended by not less than about 30 per cent. Experiments made by the Municipal Tramways Association showed that it was possible to produce, upon perfectly true rails, paint marks having exactly the same appearance and measurements as actual corrugations, the paint being applied to the wheel-treads while the car was travelling at about 12 miles per hour. It was not found possible to reproduce these counterfeit corrugations at will; but many records were obtained in different positions and in different towns. The foregoing fact, and the fact that corrugations appeared upon all kinds of track and overhead material, were sufficient to dispel the popular belief that the rolling-mill was the responsible agent. Furthur experiments made by the Association had proved conclusively that all car wheels varied in diameter, that slip and skid were continually taking place in each revolution of a wheel, and that pure rolling motion scarcely ever occurred. In Leeds and on many other tramway systems the use of high-silicon steel had resulted in the confinement of the scourge to the faintest markings, or the development had been retarded to such an extent as to afford appreciable relief.

Mr. Henry Mattinson, Chief Civil Engineer, Manchester Corporation Tramways, gave figures showing the great endurance of high-silicon steel compared with basic Bessemer steel as ascertained since 1907 in Manchester. Micrographs of the former showed a remarkably uniform structure of closely laminated pearlite. Many important factors that were not determined by chemical analysis were revealed by the microscope.

Mr. A. Millar said that, considering how baffling and perplexing the subject had proved to be, it might be inferred that corrugations were not due to any particular defect in either the design or manufacture of the rails or the rolling stock, but to a combination of circumstances; and the problem would be solved only by following up such of the theories as had been shown to have a practical bearing on the subject. For instance, the introduction of welded joints in recent years had proved the fallacy of the theory, once widely held, that corrugations were mainly attributable to imperfect joints, as corrugations of considerable magnitude were to be found on routes where only welded joints were in use.

Mr. Charles Mittelhausen said that in September, 1913, he inspected a tramway laid on a public highway on transverse ballasted sleepers, filled to the level of the rail table with ordinary macadam. After 16 years no sign of corrugation was visible, but in other parts of the city, where ordinary concrete foundations were used, corrugation was frequent nine or ten years ago. The same cars ran over both roads. In 1908 a portion of the Bexley Urban District Council Tramways which had then been worked for five years, and which was free from corrugation, was leased to the Erith Urban District Council, who supplied their own cars, and in a few weeks corrugations appeared. At the end of 12 months the lease expired and the Bexley cars resumed running, and in 14 weeks the corrugations disappeared. In 1910 the Erith cars again replaced the Bexley cars, and corrugation reappeared in 8 weeks. The cars were very similar in weight, equipment, speed, and wheel diameter, the chief points of difference being that the Bexley cars had chilled iron wheels, 4¼ inch axles, and improved springs, while the Erith cars had steel tires and 3¾ inch axles, and were somewhat dead on their springs.

Mr. E. O'Brien gave an instance of the phenomenon, which had occurred at a spot on the railway between Liverpool and Southport. The corrugation there was distinct, and extended over about ¼ mile of track; it had existed in the days of steam-hauled traffic, and still existed after ten years of electrical working. In this case, as in many others, the line ran over a bog just at the point where the corrugation occurred. The inconclusive nature of the evidence collected up to the present would lead to the conclusion that corrugation depended on the nature of the true foundation of a railway or tramway, and not merely on the nature of the upper four feet, or even ten feet of road bed.

Mr. Reginald Peters considered that an analogy might be found between rail corrugation, due to vibration of the wheel, the rail, or the road bed, and the chatter of a machine tool due to insufficient rigidity of the tool, the work, or the machine The types of rolling stock seemed too diverse to produce vibrations in unison, or if there were a tendency to do so, more consistent results would be expected. On the other hand, there was the familiar tremor imparted to the surface of the ground by the passage over it of a heavy object. This might well be of a defined though complex periodic character, and, being imparted to the rail, might cause a series of beats upon the latter by the wheel.

Mr. W. H. Sellew, of Detroit, Michigan, observed that the tendency in street railway construction in America was towards a very rigid track, and these rails corrugated badly, in spite of the percentage of carbon specified.

Mr. Stephen Sellon in the course of his reply suggested that the combination of the two features, liability to cold flow or detrusion and to skin brittleness by cold rolling, was the determining cause of rail corrugation. Mr. George Pelissier and Mr. Busse had come to conclusions very similar to those put forward in his paper, which might be summed up as saying that corrugation was a form of surface failure of the metal, and that to prevent it the one method was to increase the resistance of the metal to the stresses it had to endure. Mr. Busse concluded his report with the following sentence:—"We observe that the experiments, the experimental analyses and the metallurgical researches of the Commission appointed by the German Union of Tramways and Light Railways for the study of rail corrugations have not yet resulted in determining the factors of the phenomenon."

The whole discussion amply justified the opening remarks by Mr. John Strain on the speculative nature of the present knowledge of this subject of rail-corrugations.

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RAILWAY STATION LIGHTING BY OSRAM ATMOS TYPE LAMPS.

Taken as a whole the lighting of Great Britain's railway stations has not hitherto been particularly satisfactory either by day or by night. Especially is this true of artificial illumination, but the coming of the Osram Atmos type lamp has tempted the railway companies to depart from tradition and to light their stations so

Fig. 1.—Booking Hall, Central Station, Glasgow (Caledonian Railway Co.) lighted by Osram Atmos Type Lamps.

that they present as cheerful an appearance as possible. Many companies have already adopted the gas-filled tungsten lamp with conspicuous success and there is no doubt that with the withdrawal of the lighting restrictions now in force in many of our large towns and cities these lamps will be used in still greater quantities

Fig. 2.—Central Station, Glasgow (Caledonian Railway Co.), showing some of the platforms lighted by Osram Atmos Type Lamps.

As an example of what can and has been done we would refer to the Caledonian Railway Company's station at Glasgow, which is an excellent example of the improvements and economy which can be effected in a change-over from arc lighting. This station was originally lighted by 10-ampere open-type arc lamps, with opalescent

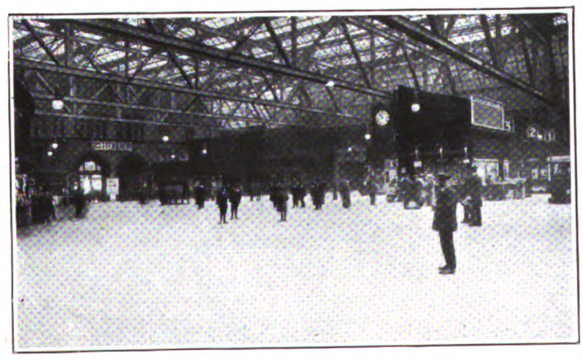

Fig. 3.—The Central Station, Glasgow (Caledonian Railway Co.) by daylight.

globes running four in series on 230 volts, the total number of arcs employed being approximately 120. Inside the main entrance containing the booking hall, offices, bookstalls, and waiting-rooms, the lamps were mounted at a height of about 22 feet, and were spaced from 60 to 80 feet apart. Along the platforms they were mounted at the same height, the average spacing being 80 feet.

These arc lamps have now been replaced by 500 watt Osram Atmos type lamps. These occupy the positions previously occupied by the arc lamps. The result has been more than satisfactory, as is exemplified by the fact that there is a reduction of 300 watts on each circuit of four lamps, while at the same time the illumination of the station has been increased and considerably improved by the more even illumination obtained from the new lamps. Moreover, they require less attention.

The horizontal illumination in the main hall of concourse is 2 ft. candles maximum, with a minimum of 1·7 ft. candles, while along the platforms the variation is between 0·8 and 1·6 ft. candles.

The photographs reproduced in Figs. 1 and 2 were taken at night, solely by the light from the Osram Atmos type lamps, and give some idea of the excellent results obtained, as evidenced by the illumination of the floors, platforms, etc. A general view by daylight, showing the old arc lamp carcases, now containing the Osram Atmos type lamps, is given in Fig. 3.

BRITISH MADE INSULATING MATERIAL.

As a consequence of the cutting off of the supply of the German lower grades of insulating material, the demand for British goods of well-known standard quality has been very great both for the home market and the export trade. Messrs. R. W. Blackwell and Company, Limited, have for many years made a speciality of all kinds of insulating material, and in order to be in a position to hold the trade after the war, as well as to meet the present demand, they have considerably increased their manufacturing facilities as well as warehouse accommodation, large stocks of their complete range of these materials being now always available for immediate delivery. In addition to the new stores at East Croydon, Messrs. Blackwell have acquired the lease of Newcastle Wharf, Nine Elms Lane, Battersea. This enables them to maintain a stock of 100,000 rolls of their roofing material, and affords them greatly increased facilities for the conduct of their over-sea trade.

The many years' experience which Messrs. Blackwell and Company have had with insulating tapes and compounds enables them to guarantee the valuable properties possessed by these materials. Every care is taken during the process of manufacture to insure thoroughly self-adhesive and highly efficient tapes without the introduction of unnecessary material to increase weight, which is so often found in so-called cheap imported goods. An exceptionally high-class compound tape, which is claimed to be more uniform than either pitch or bitumen tapes, is Blackwell's "Kurhee" tape. This has a foundation of specially strong fabric, and is saturated and coated with a highly insulative and adhesive compound. The method of manufacture ensures a tape permanently flexible and impervious to the action of acids, alkalies, or water. It will not vulcanise with heat or harden and crack from long exposure, and retains its adhesive qualities although unwound and re-used many times. It is thoroughly weatherproof and economical, and is specially recommended for power circuits, tramway and railway requirements. Other specialities are "Armorite" splicing tape and grey "Titan" adhesive tape. The former is designed to supersede pure rubber strip. It is unaffected by acids or alkalies, gives high insulation, and when wound on under tension amalgamates into a solid tube. The latter is a high-class rubber compounded linen tape, specially suitable for the mechanical protection of the former, and also for all kinds of cable joints and connections, the covering of bus bars, terminals, etc. It is claimed for this tape that it is the highest quality friction tape obtainable. The white and black tapes of the same variety are lower in price, and consequently of lower grade than the grey, but in each case they are specially manufactured for specific purposes, and are thoroughly reliable. Blackwell's electrical compound is an insulating paint of very high quality; it combines the maximum of elasticity with durability, and is unaffected by extremes of temperature, fumes, acids, alkalies, etc. It is largely used for coating rail bonds, overhead fittings, bridgework, etc., as it affords the most effectual preventive against corrosion from any cause.

Leeds and Women Conductors.—A deputation from Leeds Munitions Committee informed the City Council, on July 28, that as they had been asked to open a second factory they desired to obtain another thousand men. They suggested that the Council should release as many men as possible by employing women. Alderman R. A. Smithson, chairman of the General Purposes and the Tramways and Electricity Committees, in reply, said the Council had 670 men immediately available for Government work, but it was difficult to displace men by women unless they had definite knowledge that the men were engaged by the Munitions Committee. So far as his experience went of the towns that had engaged female labour for tramways, there was no labour market for females such as existed in a great centre like Leeds. The Corporation would take into consideration the statements that had been put forward.

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CONTRACTS AND ORDERS.

Dick, Kerr and Company, Limited, have received an order from Wolverhampton Council for twelve motor equipments.

The British Thomson-Houston Company's tender for two 500 KW. converters at £2,250 has been accepted by Luton Town Council.

Hadfields, Limited, have received an order from Stockport Council for the construction of a lay-out in manganese steel for the tramways.

Messrs. Babcock and Wilcox, Limited, have received a contract to supply a water-tube boiler to Doncaster Council's electricity works.

Bradford Council have placed orders with Ferranti, Limited, for six transformers and with the Brush Engineering Company for two transformers.

Bradford Tramways Committee have purchased for £210, from the British Thomson-Houston Company, a pair of ventilated type tramcar motors.

Bradford Electricity Committee have recommended the acceptance of the tender of the Brush Electrical Engineering Company for the supply of transformers.

Edison and Swan United Electric Light Company, Limited, have received a contract from the War Office for the supply of a large quantity of electric lamps.

Chesterfield Council have placed contracts with the British Electrical Engineering Company for a transformer, and with the British Westinghouse Company for switchgear.

Southampton Council have placed a contract with Messrs. Bradbury, Son and Company, for 3,500 tons of Tamworth coal, at £1 2s. 10d. per ton, for the electricity department.

Tudor Accumulator Company have received a contract from Aberdeen Council for welding 300 new tramway rail joints, and from Salford Council for welding about 550 tramway rail joints.

Plymouth Council have accepted Messrs. Cory Brothers and Company's tender at 29s. 6d. per ton for 13,500 tons of coal. It will be delivered by rail, the carriage being threepence a ton cheaper than by sea.

The R.E.T. Construction Company, Limited, of Finsbury Pavement House, London, E.C., and Leeds, are supplying the two additional railless cars which have recently been ordered by the Ramsbottom Council.

Car Trucks.—Bradford Tramways Committee have been advised by the Works Sub-Committee to pay an increase of £4 15s. per truck in the case of the tender of the M. and G. Truck and Engineering Company, Limited.

Messrs. Willans and Robinson have obtained the contract for the supply and erection of a 5,000 KW. turbo-alternator for Keighley Council, at £15,875, provided arrangements can be made for payments on deferred terms.

Melbourne Council have made contracts as appended :—Australian General Electric Company, 3,000 metal filament lamps ; W. T. Henley's Telegraph Works Company, trifurcating boxes ; British Westinghouse Company, oil switches.

Manchester Corporation have allotted contracts as follow :—British Insulated and Helsby Cables, Limited, and W. T. Glover and Company, Limited, cables ; E. Bennis and Company, four chain-grate stokers at Stuart Street generating station.

Sheffield Council have accepted the following tenders :—Cammell, Laird and Company, Limited, supply of 500 steel tramcar tires ; Brown, Bayley's Steel Works, Limited, supply of three special sets of 50 tramcar tires each ; Messrs. Meade, King, Robinson and Company, supply of petrol to the tramways department to December 31.

Bolton Electricity Committee have accepted the following tenders for the supply of coal :—Messrs. J. Hilton and Sons, 3,000 tons of 6 ft. slack ; J. B. Scholes and Sons, Limited, 5,000 tons rough 4 ft. slack and 15,000 tons of Ellerbeck rough Arley slack ; Earl of Ellesmere, 2,600 tons rough dry slack ; J. Briggs and Sons, 3,000 tons of best slack.

Sunderland Council have awarded contracts as appended :—British Thomson-Houston Company, Limited, reactance coils for traction motor-generator ; British Insulated and Helsby Cables, Limited, and Callender's Cable and Construction Company, Limited, cable ; Steel and Company, cable ducts ; British Westinghouse Company, Limited, instruments and switchgear for booster panel.

Portsmouth Council have accepted Walter Scott's, Limited, tender for 100 tons of steel girder tramway rails at £10 10s. per ton, 5 tons of steel fishplates at £13 10s., one ton of fishplate bolts at £17 10s., and three tons of wrought-iron tier bars at £17 10s. Other tenderers were Hadfield's, Limited ; Bayliss, Jones and Bayliss, Limited ; Bolckow, Vaughan and Company, Limited ; and Messrs. C. Richards and Sons, Darlington. For the supply of double-breasted coats for women conductors, a local tender at £1 5s. 5d. per coat was agreed to.

The British Thomson-Houston Company, Limited, of Rugby, have received an order through G. and S. Massey, of Manchester, for 93 special Fabroil pinions for power hammers for the French Government, to be used in a French munition works. Fabroil pinions have been found to be very satisfactory in operation, as they are silent, strong and durable, and reduce vibration. The Fabroil pinion department of the British Thomson-Houston Company is at present occupied with over 75 per cent. of Government work directly, and 95 per cent. directly and indirectly.

London County Council Tramways.—The following tenders have been accepted :—Supply and erection of shavings and dust removal plant for the woodworking shop at the central car repair depot (third section), Standard Engineering Company, Limited, £135 ; Sirdar Rubber Company, Limited, re-tiring five lorry wheels, £36 11s. 11d.; Cammell, Laird and Company, Limited, 90 additional driving wheel tires, £112 10s.; Heenan and Froude, Limited, spare parts for tramcar trucks, £114 17s. 11d.; British Westinghouse Electric and Manufacturing Company, Limited, six commutators for tramcar motors (type 220), £45 ; G. Robson and Company, four portable electrically-driven drilling and grinding machines, £200.

FINANCIAL REPORTS AND MEETINGS.

Hadfields, Limited, have declared an interim dividend of 1s. per share on the ordinary shares, free of income-tax.

San Paulo Tramway Light and Power Company.—The directors have declared a dividend of 2½ per cent. on the common stock.

Lanarkshire Tramways.—The directors announce an interim dividend at the rate of 5½ per cent. per annum, less income-tax, for the past half-year.

Morecambe Corporation Tramways.—The financial statement for the year ended March 31 shows a profit of £1,149, of which £1,000 was handed to the relief of rates and £149 added to reserve.

Edgar Allen and Company, Limited.—A dividend on the ordinary shares at the rate of 10 per cent. per annum, and a bonus of 2½ per cent. for the year ended March 31 last, have been declared. Similar distributions were made in each of the preceding three years.

Dublin United Tramways Dividends.—The following dividends have been declared for the half-year:—At the rate of 6 per cent. per annum, less income-tax, on preference shares, and at the rate of 5 per cent. per annum, less income-tax, on ordinary shares. In each case the dividends are the same as those declared at the corresponding period in 1914.

Plymouth Corporation Tramways.—In submitting the Tramways Committee's annual report to the Corporation, Alderman Phillips said the gross profit was £10,149, as against £10,908, notwithstanding that there had been spent on maintenance, repairs, and renewals £12,492, an increase of £2,883 on the year. Allowances had been made to employees absent on service with the forces amounting to £419. The net profit was £2,987, as compared with £4,037 twelve months ago.

Sheffield Omnibus Service.—The report of the Corporation Tramways Committee for the past year shows that the motor omnibus receipts were £16,116, and the working expenses £10,827. The sum of £1,655 is set aside for depreciation, leaving a net revenue of £3,633. After deducting interest and sinking fund payment and income-tax, there remains a balance of £2,692, which has been transferred to the special reserve fund. The fund now amounts to £3,963.

Brazilian Traction Light and Power.—The directors of the Brazilian Traction Light and Power Company, Limited, have declared a dividend of ½ per cent. on the issued ordinary capital stock, payable in Toronto on 1st September. In view of the unsettled conditions surrounding exchange with Brazil, and the low rates prevailing, and owing to the prolongation of the war, and notwithstanding that the earnings of the company have continued to increase in a very satisfactory way, the directors have decided upon the conservative policy of making the dividend on the common stock for 1915 at the rate of 4 per cent. per annum. Three per cent. has been paid for the first half of the year, and the Board has now declared a dividend of ½ per cent., making 3½ per cent. for the three-quarters of the year.

Bombay Electric Supply and Tramways Company.—The revenue for 1914 amounted to £302,570, an increase of £26,101 compared with the previous year, and expenditure to £144,987, an increase of £14,091. The net profit aggregated £157,583, an increase of £12,010, and £4,350 was brought forward. After providing for debenture interest and redemption charges, and adding £27,000 to the depreciation fund, a dividend of 6 per cent., free of income-tax, is proposed on the ordinary shares, carrying forward £8,327. The gross tramways receipts, which amounted to £169,884, compare with £170,672 for the previous year. The working expenses amounted to £85,297, against £81,123. The balance of receipts over expenses in respect of the year's working is £84,587, compared with £89,548.

United Electric Tramways of Monte Video.—The adoption of the directors' report for 1914 was proposed at the annual meeting by Mr. G. A. Touche, M.P., who referred to the depression prevalent in all South American States. Uruguay had also been visited by cyclones, which paralysed traffic for hours and days, and involved the expense of repairs to the company's properties. The number of passengers carried had decreased from 44,622,690 to 43,862,849. The operating expenses were 60·86 per cent. of the gross receipts, as compared with 59·58 per cent. in the previous year. There had been a decrease in the expenses of £2,553, but it would have required a further decrease of £4,626 to maintain the same ratio. That was impossible of achievement. For four consecutive years they had

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paid 7 per cent. on ordinary shares, so that a reduction to 4 per cent. was disappointing.

Effect of War on Glasgow Tramways.—Since the outbreak of the war 2,330 employees of Glasgow tramways have joined the forces, and Councillor Kirkland, in submitting the annual financial statement to the Council, expressed sorrow that 32 had fallen in action. In going over the figures contained in the report, as published in this journal on June 19, the councillor said that besides paying £51,000 to the relatives of the enlisted men, an expenditure of £16,000 had been incurred in carrying soldiers free on the tramways. The decrease in the year's receipts was £8,000, and in passengers 400,000. The sum of £40,000 less would be set aside for depreciation. There was a notable increase in halfpenny fares. Of the total passengers 63 per cent. took halfpenny tickets. Increases of wages had absorbed a considerable sum. The surplus of £12,951 was a great reduction on former years.

Bolton Corporation Tramways.—For the year ended March 31, 1915, the revenue amounted to £141,409 (decrease £2,365). The working expenses were £76,130 (decrease £1,063), leaving a gross profit of £65,279 (decrease £1,302). The available balance of £66,137 (decrease £7,576) has been appropriated as follows:—Interest on loans, £10,524; income-tax on profits, £1,713; repayment of loans, £17,520; reserve, renewals, and depreciation fund, £18,339; amount transferred to borough fund in aid of rates, £17,000; balance carried forward, £59. The outbreak of war in August last affected the receipts considerably. In consequence of the decision of the Council to defer all works possible until the expiration of the war, the tramways committee decided that the work of reconstruction should for this year be suspended. The car mileage amounted to 2,886,180 miles, the number of units per car-mile being 1·56. The receipts per car-mile were 11·758d., a decrease of 1·071 per cent. The percentage of working expenses to receipts was 53·836

Imperial Tramways Company.—The net revenue account shows an available balance of £31,231, and after payment of interest on the debenture stock for the whole year and interim dividend on the preference shares in respect of the half-year, amounting together to £18,084, it is proposed to appropriate the balance as follows:—Dividend at 6 per cent. per annum on the preference capital (less income-tax), paid January 1 last, £5,450; dividend for the year at 4 per cent. on the ordinary capital (less income-tax), £7,383; and to carry forward to the next account £314. The company's services of cars and omnibuses had been maintained not without difficulty, owing to the war conditions prevailing on the North-East Coast, and to one-third of the staff having joined the forces. Sir George White, presiding at the annual meeting, said the increased receipts of the Middlesbrough and district undertaking, viz., £3,276, arose entirely from the working of motor omnibuses. They intended to supply similar facilities for other districts immediately after a return to normal conditions.

Newcastle Corporation Tramways.—Mr. Earnest Hatton, general manager of the Corporation Tramways, has issued to the Tramways Committee the annual statement of accounts, which were formally presented to the Council on July 29 by Alderman J. H. Rodgers, chairman of the committee. The total income was £293,263, including £1,704 for parcels carried, and there was a total increase over the aggregate for 1913-14 of £32,062. The sum of £79,329 was expended on traffic expenses, £25,579 for general expenses, £31,120 for general repair and maintenance, £17,909 for power expenses and maintenance and repairs at the power station, £1,240 for electricity purchased from Newcastle and District Company, and £5,279 for public lighting; making a total of £160,457, as against £147,552, or an increase of £12,905. This increase is almost accounted for by an increase of £7,437 in the traffic expenses, and of £3,970 for general repairs and maintenance. The large increase in the traffic expenses was caused by concessions granted to the employees. The figure does not include the sum of £4,364, which the committee have paid to the dependents of men on active service. The net balance to be carried forward was £132,806, as against £113,648. To appropriation account £99,458 was carried and out of that amount there was paid £43,355 to the sinking fund and on loans repaid; £1,381 to the Corporation in respect of the debt on the horse car system; £18,000 bonus to the rates; £362 for chassis; £4,364, allowances to the dependents of men on active service; and £6,236 for motor omnibuses. The balance of £24,822 was carried to the reserve and renewal account, as compared with £25,134 in 1913-14. Out of the reserve fund of £119,160 there was spent last year £44,504 on renewals, thus reducing the fund to £74,655, or £25,000 below the minimum level at which the committee decided it should be kept. Alderman Rodgers remarked that the position of the reserve fund emphasised what he had pointed out to the Council—how essential it was not to contribute so much to the rates as had been done during the last two years, in order that the reserve fund might be brought up to its proper level. Out of the reserve fund, since the inception of the electric system, there had been paid for renewals the sum of £115,301. The period was being reached when larger demands would be made for renewals, and if during the first twelve years the cost of renewals had been £115,000, that went to prove how essential it was that the reserve fund should be maintained year by year by the addition of at least from £25,000 to £30,000.

London County Council Tramways.—The appended statement shows the chief items in the London County Council Tramways accounts during the past two years. A general statement of the past year's trading has already been given:—

	1914-15.	1913-14.	Inc. or Dec.
Capital expenditure	£13,315,723	£13,028,119	+ £287,604
Amount outstanding	£9,836,187	£9,923,187	− £87,000
Reserve fund	£163,050	£196,223	− £33,173
Renewals fund	£402,045	£543,858	− £141,813
Total track mileage	149·7455	146·2055	+ 3·54
Passenger cars in stock	1,730	1,722	+ 8
Traffic revenue	£2,333,391	£2,202,489	+ £130,902
Working expenses (electric) (a)	£1,042,034	£1,585,251	+ £56,783
Working expenses (horse)	£16,328	£30,215	− £13,887
Gross balance	£741,485	£653,202	+ £88,283
Deficiency	£33,173	£88,526	− £53,453
Passengers carried (b)	550,497,992	522,952,740	+ 27,545,252
Fare per passenger	1·78d.	1·88d.	− ·10d.
Car mileage	58,078,792	59,209,289	− 230,497
Units per car mile	2·60	2·63	− ·03
Power cost per car-mile	1·02d.	1·01d.	+ ·01d.
Traffic receipts per electric car-mile ...	9·50d.	8·94d.	+ ·56d.
Expenses per electric car-mile ...	6·89d.	6·50d.	+ ·39d.
Ratio of working expenses (electric) ...	68·73%	70·55%	− 1·82%

(a) Exclusive of £42,209 war service allowances. (b) In 1914-15 transfers counted as only one passenger.

Manchester Corporation Tramways.—The annual report, to which we have previously referred, shows a net surplus of £148,584, of which sum £48,584 was transferred to reserve, renewals, and depreciation account, and £100,000 to the rates. The previous year the surplus was £200,309. The war caused a drop in revenue of £23,434. Working expenses fell from £585,223 to £572,441, but war service allowances for 1,554 men, entailing an outlay of £31,763, have to be added. Appended are the chief details in the year's accounts:—

	1914-15.	1913-14.	Inc. or Dec.
Capital expenditure	£2,216,008	£2,130,903	+ £85,105
Amount outstanding	£1,948,183	£1,926,002	+ £22,181
Total track mileage	203	202	+ 1
Number of cars in stock	683	662	+ 21
Reserve, renewals, and depreciation ...	£48,584	£97,219	− £48,635
Total renewals and depreciation ...	£428,000	£468,952	− £40,952
Traffic revenue	£887,762	£911,223	− £23,461
Total revenue	£901,875	£925,309	− £23,434
Working expenses	£604,205	£585,223	+ £18,982
Gross balance	£297,670	£340,085	− £42,415
Net profit	£148,584	£200,309	− £51,725
Passengers carried	202,768,420	205,608,741	+ 2,840,321
Average fare per passenger	1·06d.	1·06d.	—
Car mileage	19,155,051	19,463,046	− 307,359
Units per car-mile	1·562	1·543	+ ·019
Power cost per car-mile	1·608d.	1·597d.	+ ·011
Traffic receipts per track mile	£4,835	£5,054	− £219
Traffic receipts per car-mile	11·123d.	11·236d.	− ·113d.
Expenses per car-mile	7·172d.	7·216d.	− ·044d.
Ratio of working expenses	63·47%	63·25%	− ·22%

The slight increase in the consumption of power per car-mile is due probably to the increased number of bogie cars in service and to the large number of cars fitted with top covers. Of the total of 683 cars, 282 are double truck, 351 single truck, and 50 combination. There are top covers to 552 cars.

West Ham Corporation Tramways.—Below will be found a statistical statement based on the accounts for the past two years. The net result for last year was a surplus of £272, as against a deficit for the previous year of £14,421. The surplus excludes the sum of £6,031 for war allowances, which the Council decided should be defrayed out of the rates:—

	1914-15.	1913-14.	Inc. or Dec.
Capital expenditure	£556,878	£556,878	—
Amount outstanding	£512,214	—	—
Total track mileage	30	30	—
Depreciation and renewals	£692	—	—
Total depreciation and renewals	£26,236	£32,740	− £6,504
Number of cars in stock	118	118	—
Traffic revenue	£147,703	£142,034	+ £5,669
Total revenue	£154,037	£145,189	+ £8,848
Working expenses	£119,935	£126,174	− £6,239
Gross balance	£34,102	£19,015	+ £15,087
Net profit	£272	− £14,421	+ £14,693
Passengers carried	42,667,561	41,152,501	+ 1,515,060
Average fare per passenger	·852d.	·828d.	+ ·024
Car mileage	3,760,361	3,756,354	+ 4,007
Units per car-mile	1·66	1·85	− ·19
Power cost per car-mile	1·24d.	1·353d.	+ ·887d.
Traffic receipts per track mile	£5,041	£4,726	+ £315
Traffic receipts per car-mile	9·83d.	9·27d.	+ 0·56d.
Expenses per car-mile	7·65d.	8·061d.	− ·996d.
Ratio of working expenses	78%	88%	− 10%

During the eleven years since the undertaking was inaugurated £35,784 has been voted to the rates and £74,752 has been paid for street improvements. Mr. J. S. D. Moffet, the general manager, remarks that although the total income constitutes a record, the expenditure has increased to such an extent, owing to the continued rise in prices of material and cost of labour, that it may be necessary for the committee to consider the question of revising certain fares and stages if an even balance sheet is to be maintained. This year the cost of labour will increase by £3,100.

(*Continued on page* 133.)

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Year Ended.	Electric Traction Inaugurated.	System.	Line open (single track). Mls. Chs.	Borrowing Powers.	Borrowing Powers Exercised.	Unexhausted Borrowing Powers.	Total Capital Expenditure.	Capital Expenditure per Mile of Single Track.	Loans Outstanding.	Loans Repaid and Sinking Fund.	Depreciation, Renewal and Reserve Funds.	Gross Receipts. Traffic.	Other.	Total.
Aberdeen	May 31, 1915	Dec., 1899	E.	27 56	415,000	366,332	48,668	366,332	13,225	...	251,342	189,803	86,614	1,388	**88,002**
Accrington	Mar. 31, 1914	Aug., 1907	,,	10 53	181,925	133,875	48,050	134,734	12,636	113,870	20,864	16,581	29,843	350	**30,193**
Ashton-u-Lyne	Mar. 25, 1914	Aug., 1902	...	8 15	130,070	109,814	20,256	109,814	13,412	73,958	32,270	2,950	23,341	677	**24,019**
Ayr	May 15, 1914	Sept., 1901	,,	9 30	128,000	98,630	29,369	100,841	10,756	79,171	19,460	16,489	18,315	1,062	**19,377**
Birmingham	Mar. 31, 1914	Jan., 1904	,,	114 44	2,577,611	2,352,104	225,507	2,334,437	20,379	1,913,559	438,545	186,154	628,016	7,455	**635,471**
Blackburn	Mar. 25, 1915	Mar., 1899	,,	24 63	408,174	342,474	65,700	336,258	13,566	354,600	191,985	3,718	65,158	3,144	**68,302**
Blackpool	Mar. 31, 1914	June, 1899	,,	(p)21 33	453,798	310,994	142,804	310,994	14,524	310,994	126,036	21,660	84,034	763	**84,797**
Bolton	Mar. 31, 1915	Dec., 1899	,,	47 69	551,092	551,092	...	570,981	11,930	348,111	202,980	43,059	140,182	1,228	**141,410**
Bradford	Mar. 31, 1914	July, 1898	,,	(h)106 29	1,280,788	1,061,113	219,675	1,040,118	9,779	653,504	420,844	82,898	298,525	18,608	**317,133**
Brighton	Mar. 31, 1915	Nov., 1901	,,	17 15	378,093	279,978	98,115	280,392	16,314	211,268	69,124	7,562	54,413	2,113	**56,526**
Burnley	Mar. 31, 1914	Dec., 1901	,,	22 18	388,052	325,999	62,053	232,501	10,461	179,136	64,381	39,684	88,050	266	**88,316**
Burton-on-Trent	Mar. 31, 1914	Aug., 1903	,,	10 50	108,632	104,562	4,070	106,275	10,121	49,239	55,323	10,134	15,010	1,497	**16,507**
Bury	Mar. 31, 1915	June, 1903	,,	(b)36 10	407,800	284,745	123,055	293,237	12,826	254,832	55,416	33,960	68,740	276	**69,016**
Chester	Mar. 25, 1914	April, 1903	,,	6 35	92,991	82,380	10,611	82,934	12,883	68,477	14,121	4,282	12,793	480	**13,273**
Chesterfield	Mar. 31, 1914	Dec., 1904	,,	5 8	98,000	73,500	24,500	69,810	13,663	57,660	13,820	6,307	13,608	465	**14,073**
Colchester	Mar. 31, 1915	July, 1904	,,	7 75	70,748	69,555	1,193	69,471	8,736	48,360	22,007	Nil.	13,413	380	**13,793**
Croydon	Mar. 31, 1914	(q) Sept., 1901	,,	17 50	287,689	287,689	Nil	284,847	16,162	229,300	96,719	42,352	84,926	2,100	**87,026**
Darlington	Mar. 31, 1914	June, 1904	,,	8 71	107,500	77,832	29,668	77,786	8,752	56,178	23,338	6,806	12,976	261	**13,237**
Darwen	Mar. 31, 1914	Oct., 1900	,,	7 13	93,400	86,300	7,100	85,831	11,984	55,090	30,892	8,500	15,631	1,003	**16,634**
Derby	Mar. 31, 1914	July, 1904	E.	22 20	239,980	239,980	...	245,332	11,026	177,676	67,656	(l)32,356	£51,126	1,048	**52,174**
Doncaster	Mar. 31, 1914	June, 1902	E.	12 58	...	...	...	107,921	8,481	94,700	16,581	1,442	22,890	318	**23,208**
Dundee	May 15, 1914	July, 1900	,,	28 32	(f)'	354,783	...	362,116	12,751	264,720	90,062	82,966	67,754	1,750	**69,504**
East Ham	Mar. 31, 1914	June, 1901	,,	14 5	190,643	190,242	401	191,654	13,127	140,457	65,478	3,453	54,079	836	**54,915**
Exeter	Mar. 31, 1914	April, 1905	,,	7 0	106,000	86,111	19,889	86,111	12,301	67,354	19,249	6,290	17,489	97	**17,586**
Gloucester	Mar 31, 1915	April, 1904	,,	15 1	191,000	144,333	46,667	147,783	9,846	104,965	22,901	1,000	16,693	1,114	**17,807**
Halifax	Mar. 31, 1915	June, 1898	,,	55 39	449,263	417,466	31,797	420,185	7,570	283,249	129,670	36,442	111,792	1,033	**112,825**
Ilford	Mar. 31, 1914	Mar., 1903	,,	11 28	149,633	149,633	Nil	149,574	13,178	104,842	44,791	2,297	23,485	2,308	**25,793**
Ilkeston	Mar. 31, 1914	May, 1903	,,	3 56	64,214	47,000	17,214	47,833	13,436	31,462	16,422	...	6,915	171	**7,086**
Ipswich	Mar. 31, 1914	Nov., 1903	,,	14 70	116,471	114,300	2,171	115,676	7,776	96,912	18,447	11,994	22,964	862	**23,826**
Keighley	Mar. 31, 1913	Oct., 1904	,,	6 9	50,934	47,328	3,606	47,328	7,743	32,468	16,961	942	8,845	313	**9,158**
Kilmarnock	May 15, 1914	Dec., 1904	,,	5 47	65,000	52,795	12,205	53,281	9,536	47,250	8,707	5,298	9,088	265	**9,353**
Kirkcaldy	May 15, 1915	Feb., 1903	,,	8 65	213,000	97,868	115,132	97,868	11,105	76,466	21,402	5,223	16,564	412	**16,976**
Lancaster	Mar. 31, 1914	Jan., 1903	,,	4 65	...	45,700	...	43,684	9,077	30,450	15,350	3,074	5,779	158	**5,937**
Leith	May 15, 1914	Aug., 1905	,,	17 73	275,000	238,000	37,000	236,877	13,211	179,350	58,650	3,045	36,555	1,170	**37,725**
Leyton	Mar. 31, 1914	Dec., 1906	,,	18 8	324,201	324,145	56	295,376	16,319	240,741	57,244	2,654	69,148	1,541	**70,689**
Lincoln	Mar. 31, 1915	Nov., 1905	S.	2 77	98,519	44,947	53,572	44,987	15,185	40,226	12,529	(l) 692	6,435	117	**6,552**
Liverpool	Dec. 31, 1914	Nov., 1898	E.	124 0	2,622,786	2,057,850	564,936	2,062,391	16,741	1,168,685	1,177,949	366,545	684,026	13,050	**697,076**
Lowestoft	Sep. 30, 1914	July, 1903	,,	4 6	96,230	91,178	5,052	91,178	22,375	75,480	17,614	Nil	11,357	373	**11,730**
Maidstone	Mar. 31, 1914	July, 1904	,,	7 3	82,932	82,932	...	79,098	11,239	65,574	17,358	...	10,391	575	**10,966**
Manchester	Mar. 31, 1915	June, 1901	,,	203 31	2,361,038	2,207,215	153,823	2,216,009	10,895	1,648,183	548,499	438,497	887,763	14,112	**901,875**
Nelson	Mar. 31, 1914	Feb., 1903	,,	3 69	38,000	37,885	115	37,885	9,808	29,145	8,740	...	10,801	52	**10,853**
Newport (Mon.)	Mar. 31, 1914	April, 1903	,,	14 28	219,250	196,250	23,000	194,983	13,588	159,734	45,350	4,055	40,151	1,039	**41,190**
Nottingham	Mar. 31, 1915	Jan., 1901	,,	44 20	...	...	...	733,674	16,586	473,999	261,364	56,626	176,289	3,026	**179,315**
Oldham	Mar. 25, 1914	May, 1902	,,	28 6 (b) 8 31	509,723	442,047	67,676	444,565	15,835	311,148	133,167	8,455	114,481	1,689	**116,170**
Perth	May 15, 1913	Nov., 1905	,,	6 60	90,000	78,350	11,650	78,629	11,649	63,340	15,489	1,673	8,761	509	**9,270**
Plymouth	Mar. 31, 1914	Sept., 1899	,,	15 0	182,856	181,479	1,377	219,417	14,628	86,903	89,493	24,252	39,989	891	**40,880**
Pontypridd	Mar. 31, 1913	Mar., 1905	,,	8 48	136,019	135,919	100	137,148	15,946	109,757	26,052	Nil	21,580	313	**21,893**
Rawtenstall	Mar. 31, 1915	May, 1909	,,	15 71	193,290	182,172	11,118	182,276	11,709	150,324	31,848	3,051	24,460	1,076	**25,536**
Rochdale	Mar. 31, 1915	May, 1902	,,	(i)40 2	356,991	347,782	9,209	353,200	15,407	347,782	108,034	16,000	77,660	5,742	**83,402**
Rotherham	Mar. 31, 1914	Jan., 1903	,, R.T	12 2 ...	342,200 ...	183,775 ...	158,325 ...	184,859 ...	14,537 ...	152,244 ..	33,481 ...	24,632 ...	44,495 5,757	70 ...	**44,565 5,767**
Salford	Mar. 31, 1914	Oct., 1901	E.	75 64	1,050,666	724,469	326,197	723,923	9,554	532,821	191,648	28,492	272,758	54	**272,812**
Southampton	Mar. 31, 1915	Jan., 1900	,,	18 54	280,452	260,699	19,753	259,834	13,913	158,729	99,470	14,251	68,042	2,996	**71,038**
Southend-on-Sea	Mar. 31, 1913	July, 1901	,,	11 49	130,000	129,961	39	143,808	12,384	116,940	12,784	3,045	34,453	465	**34,918**
Southport	Mar. 31, 1914	July, 1900	,,	(d) 10 63	294,000	197,730	94,270	196,178	9,921	150,250	47,480	442	18,391	455	**18,846**
South Shields	Mar. 31, 1914	Mar., 1906	,,	10 21	251,882	175,056	76,826	173,599	16,916	146,912	33 413	(l)26,881	37,744	586	**38,330**
Staly'ge, H., M., D.	Mar 31, 1915	May, 1904	,,	27 57	325,270	280,990	44,280	279,778	10,096	209,387	71,603	1,211	37,490	130	**37,620**
Stockport	Mar. 31, 1914	Aug., 1901	,,	27 5	318,847	234,500	84,347	251,514	9,294	158,391	76,109	37,179	66,715	1,322	**68,037**
Sunderland	Mar. 31, 1915	Aug., 1900	,,	20 28	308,699	303,211	5,488	306,766	15,074	161,996	132,265	45,044	75,229	386	**75,615**
Swindon	Mar. 31, 1914	Sept., 1904	,,	4 42	...	...	...	44,216	9,771	33,861	11,738	7,237	8,602	309	**8,911**
Wallasey	Mar. 31, 1914	Mar., 1902	,,	19 77	198,867	195,290	3,577	216,498	10,848	161,934	64,221	9,520	63,151	562	**63,713**
Walsall	Dec. 31, 1914	Dec., 1902	,,	19 44	188,145	188,100	45	182,926	9,357	154,044	63,649	34,960	33,311	778	**34,089**
Walthamstow	Mar 31, 1914	June, 1905	,,	13 30	198,000	194,000	4,000	188,192	14,070	171,716	21,781	1,940	38,590	718	**39,308**
Warrington	Mar. 31, 1914	April, 1902	,,	9 52	103,674	102,896	778	102,128	10,583	70,476	32,422	10,000	23,232	521	**23,753**
West Ham	Mar. 31, 1914	Feb., 1904	,,	30 4	563,478	551,588	11,890	556,878	18,532	527,934	104,716	32,740	142,034	3,155	**145,189**
West Hartlepool	Mar. 31, 1915	...	,,	8 63	85,494	80,330	5,164	81,731	9,301	76,501	3,682	4,614	19,011	494	**19,505**
Wigan	Mar. 31, 1914	April, 1901	,,	30 73	500,955	483,757	17,198	473,906	15,349	392,118	142,815	804	77,973	1,375	**79,348**
Wolverhampton	Mar. 31, 1915	April, 1902	S.	21 40	279,733	268,185	11,548	292,361	13,596	209,497	71,812	53,987	54,593	730	**55,323**
Yarmouth (Gt.)	Mar. 31, 1914	June, 1902	E.	14 58	149,600	124,750	24,850	126,363	9,207	116,450	25,996	9,075	25,712	527	**26,239**
York	Mar. 31, 1914	Jan., 1910	,,	12 20	157,150	157,150	340	156,810	12,853	152,470	6,323	5,092	26,133	642	**26,775**

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	Mar. 31, 1915	Nov., 1905	E.	98 54	1,528,146	1,381,200	136,946	1,455,506	14,702	1,343,000	257,730	96,622	266,249	3,988	**270,237**
Bexley	Mar. 31, 1914	Oct., 1903	,,	6 42	100,798	98,812	1,986	98,408	15,376	75,408	23,403	942	14,698	1,649	**16,346**
Birkenhead	Mar. 31, 1914	Feb., 1901	,,	24 7	376,398	369,528	6,870	371,097	15,406	239,201	130,267	22,655	67,725	4,300	**72,025**
Bournemouth	Mar. 31, 1914	July, 1902	,,	(e)29 62	471,850	432,440	39,410	443,006	19,821	286,385	146,054	18,409	104,353	616	**104,969**
Cardiff	Mar. 31, 1914	May, 1902	,,	31 66	830,382	787,292	43,090	786,510	24,714	514,059	273,232	104,002	141,519	24,681	**166,200**
Coventry	Mar. 31, 1914	Jan., 1912	,,	15 61	251,014	235,574	15,440	229,197	14,541	230,596	8,517	3,983	42,751	733	**43,484**
Glasgow	May 31, 1915	Oct., 1898	,,	198 10 (b) 2 53	4,564,266	3,694,143	870,123	3,751,708	19,127	2,411,868	1,282,275	2,326,543	1,070,694	6,184	**1,076,878**
Huddersfield	Mar. 31, 1914	Feb., 1901	,,	48 41	772,662	407,142	365,520	458,878	9,460	239,984	176,542	30,974	112,660	3,660	**116,320**
Hull	Mar. 31, 1915	July, 1899	,,	33 12	662,074	594,626	67,448	596,092	17,982	579,628	183,392	147,663	161,750	1,280	**163,030**
Leeds	Mar. 31, 1915	Aug., 1897	,,	115 71	1,907,865	1,814,758	93,107	1,678,844	14,487	1,400,687	590,421	4,961	429,902	4,038	**433,940**
Leicester	Dec. 31, 1914	May, 1904	,,	37 0	1,006,946	818,073	138,290	828,953	22,404	674,936	147,944	91,843	149,664	20,571	**170,235**
London	Mar. 31, 1914	...	H.	13 73	(c)	(c)	(c)	13,028,119	...	...	...	...	21,145	480	**21,635**
		May, 1903	C.E	277 26						9,923,528	3,370,966	730,346	2,181,344	65,698	**2,247,042**
N'castle-on-Tyne	Mar. 31, 1914	Dec., 1901	E.	62 72	1,522,010	1,277,747	244,263	1,284,380	20,428	929,766	428,119	94,337	251,024	10,177	**261,201**
Northampton	Mar. 31, 1914	July, 1904	,,	9 16	239,800	127,255	112,545	126,431	13,742	87,022	40,501	11,834	28,527	812	**29,339**
Portsmouth	Mar. 31, 1914	Sep., 1901	,,	34 51	708,618	708,618	...	772,684	22,308	449,206	259,413	75,054	115,168	1,823	**116,991**
Preston	Mar. 31, 1914	June, 1904	,,	17 16	224,102	187,269	36,833	187,269	10,888	117,315	47,130	39,392	45,618	328	**45,946**
Reading	Mar. 31, 1914	July, 1903	,,	13 14	235,000	234,000	1,000	230,763	17,515	162,634	68,159	18,371	35,282	1,043	**36,325**
Sheffield	Mar. 25, 1915	Sep., 1899	,,	79 8	1,782,471	1,484,400	298,071	1,558,246	19,703	1,122,482	512,567	41,384	391,534	2,997	**394,531**
Wellington, N.Z.	Mar. 31, 1914	...	,,	31 55	496,423	496,423	...	628,151	19,821	496,423	46,836	120,191	157,096	1,161	**158,257**

C—Electric conduit system. E—Electric trolley system. H—Horse lines RT—Railless trolley system. S—Surface contact system.
(b) Includes leased lines. (c) Conferred by Annual Money Act, which limits amount for each financial year. Powers not exercised are lapsed.
(d) Not including 8 m. 78 ch. leased lines. (e) Includes 7 mi. 34 chs. leased lines. (f) Unlimited. (h) Includes 1¼ miles railless trolley route. (i) 17 mi. 8 chn. single track leased.
(k) Not including 10 miles 3 chains single track lines leased. (l) Including Insurance. (p) Including leased lines. (q) Corporation working commenced June, 1906.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Working Expenses.					Gross Profit on Working.	Additions to Gross Profit.	Deductions from Gross Profit.						Net Surplus + or Deficit −
	Traffic.	General.	Repairs & Maintenance.	Power.	Total.			Interest.	Sinking Fund.	Income Tax.	Depreciation & Renewal	Sundries.	Total.	
Aberdeen	23,291	12,148	7,920	8,166	51,525	36,477	...	4,789	5,179	...	13,840	(i) 1,669	25,477	+ 11,000
Accrington	7,570	2,792	2,268	4,880	17,510	12,683	...	3,969	3,783	198	3,100	65	11,115	+ 1,568
Ashton-under-Lyne	5,149	1,682	3,053	3,372	13,256	10,763	...	2,590	3,760	477	800	39	7,666	+ 3,097
Ayr	4,206	2,093	1,905	2,457	10,661	8,716	...	(h) 2,558	1,744	164	2,503	606	7,575	+ 1,141
Birmingham	183,119	59,947	88,698	113,743	445,507	189,964	8,487	68,478	53,804	...	...	197	122,479	+ 75,972
Blackburn	16,859	6,197	14,451	9,421	46,928	21,374	287	(h) 4,388	15,450	251	1,572	...	21,661	...
Blackpool	16,643	6,851	9,719	10,273	43,486	41,311	...	(h) 9,429	7,329	...	10,000	...	26,758	+ 14,553
Bolton	30,044	(q) 9,486	15,912	20,689	76,131	65,279	857	(h) 10,525	17,520	1,713	18,339	(i) 981	49,078	+ 17,058
Bradford	92,305	29,243	58,991	50,611	231,150	85,983	3,877	20,443	31,822	3,888	11,454	5,053	72,660	+ 17,200
Brighton	14,152	(i) 6,759	13,690	8,384	42,985	13,541	55	7,661	5,917	...	...	...	13,578	+ 18
Burnley	23,284	7,571	11,998	20,096	62,949	25,367	...	6,939	7,728	1,072	...	(f) 1,941	17,680	+ 7,687
Burton-on-Trent	5,442	1,502	2,562	3,154	12,660	3,847	(q) 1,524	1,364	1,344	...	1,500	...	4,208	+ 1,163
Bury	16,129	4,971	7,162	7,504	35,766	33,250	303	(h) 7,037	6,026	825	2,472	(w) 11,193	27,553	+ 6,000
Chester	3,290	1,534	1,208	2,096	8,128	5,145	158	(h) 2,754	1,018	...	...	...	3,772	+ 1,531
Chesterfield	3,214	1,368	2,936	2,192	9,710	4,363	269	2,275	1,900	...	...	...	4,175	+ 457
Colchester	3,045	1,372	2,370	2,783	9,570	4,223	28	(h) 1,986	2,496	...	...	(i) 172	4,654	− 403
Croydon	29,938	6,976	14,626	18,203	69,743	17,283	664	7,943	7,415	1,227	...	1,132	17,717	+ 230
Darlington	4,305	812	1,995	2,012	9,124	4,113	101	(h) 1,944	1,936	102	469	...	4,511	− 297
Darwen	3,980	1,018	3,287	2,569	10,854	5,780	156	2,247	2,190	...	1,050	...	5,487	+ 449
Derby	E 17,320 H 540	2,906 ...	5,499 81	8,610 ...	34,335 621	17,839 def. 173	239	6,236	3,464	...	5,536	(l) 185	15,421	+ 2,657
Doncaster	4,969	1,342	6,550	4,166	17,027	6,181	16	2,935	1,840	138	572	58	5,543	+ 654
Dundee	17,495	5,964	9,477	10,502	43,438	26,066	...	8,742	6,400	211	9,701	...	25,054	+ 1,012
East Ham	18,739	6,802	12,067	10,521	48,129	6,786	...	(h) 5,570	6,882	...	...	573	13,025	− 6,239
Exeter	4,888	1,373	1,483	3,827	11,571	6,015	...	(h) 2,305	1,885	101	...	...	4,291	+ 1,724
Gloucester	7,250	1,643	2,975	1,836	13,704	4,103	...	(h) 5,362	1,881	370	...	...	7,613	− 3,510
Halifax	30,501	7,877	13,529	21,557	73,504	39,321	345	10,424	12,106	...	850	(i) 2,632	26,012	+ 13,654
Ilford	9,916	2,432	3,740	4,791	20,878	4,915	557	3,969	5,070	...	...	...	9,039	− 3,567
Ilkeston	2,262	789	1,378	1,460	5,889	1,197	160	1,450	1,532	90	...	96	3,168	− 1,811
Ipswich	8,538	2,250	5,578	3,522	19,888	3,938	...	(h) 3,624	2,142	...	...	...	5,766	− 1,828
Keighley	2,692	768	899	1,612	5,971	3,187	179	1,116	1,881	...	...	(n) 369	3,366	...
Kilmarnock	3,195	746	1,327	1,717	6,985	2,368	...	1,628	1,252	...	1,160	...	4,040	− 1,672
Kirkcaldy	4,811	1,416	2,312	2,912	11,451	5,525	68	2,604	2,411	...	409	136	5,560	+ 33
Lancaster	2,290	522	841	1,594	5,247	690	52	1,158	1,511	...	...	...	2,669	− 1,927
Leith	9,742	3,131	5,080	3,920	21,873	15,852	242	(h) 6,211	7,850	...	2,274	67	16,402	− 308
Leyton	(p) 22,360	8,611	13,711	12,923	57,605	13,084	133	10,007	8,461	...	...	202	18,670	− 5,453
Lincoln	1,446	656	967	872	3,941	2,611	47	1,529	1,071	...	...	(i) 6	2,606	+ 52
Liverpool	192,352	69,830	83,100	123,527	468,809	228,267	25,231	50,082	63,726	...	(d) 34,821	(e) 4,869	153,498	+ 100,000
Lowestoft	3,405	655	1,552	2,323	7,935	3,795	..	2,441	2,251	...	...	...	4,692	− 897
Maidstone	2,609	1,062	1,686	1,934	7,291	3,675	57	2,470	1,969	...	...	114	4,553	− 821
Manchester	273,002	(i) 117,573	85,280	128,350	604,205	297,670	14,615	(h) 58,243	57,599	13,790	48,584	(c) 34,069	212,285	+ 100,000
Nelson	2,537	684	1,525	2,123	6,869	3,984	...	978	1,026	...	...	...	2,004	+ 1,980
Newport (Mon.)	10,513	4,240	13,070	6,670	34,493	6,697	925	5,850	4,231	...	...	158	10,239	− 2,617
Nottingham	48,272	14,674	17,408	30,692	111,046	68,269	...	16,444	21,121	...	...	(i) 2,040	39,605	+ 28,664
Oldham	26,908	8,585	22,246	20,564	78,303	37,867	1,317	15,559	11,718	1,352	...	(g) 5,654	34,283	+ 4,901
Perth	3,182	698	418	1,252	5,550	3,720	50	1,523	1,632	3	612	...	3,770	...
Plymouth	8,430	3,896	4,514	8,026	24,866	16,014	1,257	4,282	3,141	690	5,121	...	13,234	+ 4,037
Pontypridd	5,017	1,395	5,476	3,196	15,084	6,809	1,754	(h) 4,009	4,160	...	...	39	8,208	+ 355
Rawtenstall	6,126	2,446	3,187	4,273	16,032	9,504	85	5,483	6,493	...	...	...	11,976	− 2,387
Rochdale	19,308	5,063	10,984	11,537	46,892	36,510	1,636	11,478	9,594	2,038	...	(i) (s) 10,752	33,852	+ 4,284
Rotherham	E 10,374 RT 1,310	3,084 409	7,888 1,434	9,918 658	31,264 3,811	13,301 1,946	209 31	5,008 400	3,465 568	... ...	... ...	...	8,473 968	+ 5,037 + 1,009
Salford	79,460	23,804	25,203	50,303	178,770	94,042	5,044	(h) 17,392	22,470	2,760	5,674	(k) 28,790	77,086	+ 22,000
Southampton	21,466	(i) 6,862	9,433	12,545	50,306	20,732	(t) 6,757	7,564	7,557	952	5,000	...	21,073	+ 6,416
Southend-on-Sea	8,046	2,260	3,534	6,187	20,027	14,891	4,228	(h) 3,834	1,753	...	4,017	...	9,605	+ 9,514
Southport	4,754	2,126	3,103	2,999	12,982	5,864	6,379	6,516	5,018	...	2,144	...	13,678	− 1,435
South Shields	8,838	3,715	3,633	6,399	22,585	15,745	265	(h) 5,333	3,570	...	...	...	8,903	+ 7,107
Staly'dge, H., M., D.	12,818	(i) 5,022	7,448	5,761	32,049	5,571	...	7,485	7,786	...	400	397	16,068	− 10,497
Stockport	14,828	4,583	10,045	5,964	35,420	32,617	1,170	5,432	8,909	1,163	2,369	(j) 3,414	21,287	+ 12,500
Sunderland	19,807	5,608	4,867	11,267	41,549	34,066	265	(h) 6,464	10,374	1,218	10,875	400	29,331	+ 5,000
Swindon	2,854	828	1,534	1,850	7,066	1,845	45	1,215	1,422	...	...	...	2,637	− 747
Wallasey	17,686	4,792	6,512	11,500	40,490	23,223	92	5,603	4,885	...	...	634	11,122	+ 12,193
Walsall	8,510	3,326	4,315	5,670	21,821	12,268	1,339	4,962	3,975	551	640	...	10,128	+ 3,479
Walthamstow	14,821	3,234	7,416	8,568	34,039	5,269	301	(h) 6,396	3,265	...	3,645	...	13,306	− 7,736
Warrington	5,939	1,834	3,973	3,411	15,217	8,536	537	2,481	3,353	...	...	...	5,834	+ 3,239
West Ham	53,477	18,084	33,440	21,174	126,175	19,014	...	20,056	12,398	692	...	290	33,436	− 14,422
West Hartlepool	4,791	1,586	2,956	2,241	11,574	7,931	3	2,569	1,847	...	..	(f) 500	4,916	+ 3,018
Wigan	16,604	5,226	11,643	11,016	44,489	34,859	308	14,197	12,561	...	...	(e) 3,719	30,477	+ 4,690
Wolverhampton	13,031	(i) 6,239	8,594	7,202	35,066	20,257	(x) 2,535	7,760	5,669	203	5,416	...	19,048	+ 3,744
Yarmouth (Gt.)	7,756	1,849	3,052	4,951	17,608	8,631	75	(h) 4,065	2,826	...	1,815	...	8,706	...
York	8,713	2,028	1,936	5,259	17,936	8,839	...	(h) 4,609	1,706	...	...	...	6,315	+ 2,524

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	75,752	17,245	35,294	28,622	156,913	113,325	...	48,342	31,277	1,478	17,879	2,164	101,140	+ 12,185
Bexley	3,282	1,382	*3,554	828	(s) 11,630	4,716	...	2,794	2,509	...	324	...	5,627	− 911
Birkenhead	17,015	5,374	11,759	10,744	44,892	27,133	83	(h) 11,577	9,499	373	5,712	55	27,216	...
Bournemouth	24,154	8,350	10,307	16,200	59,011	45,958	2,550	(h) 10,265	15,255	...	12,871	(e) 8,117	46,508	+ 2,000
Cardiff	44,037	11,121	18,146	26,260	99,564	66,636	2,592	23,941	23,014	2,835	6,946	...	56,736	+ 12,492
Coventry	12,861	4,471	7,945	3,839	29,116	14,368	478	8,506	5,230	...	277	414	14,427	+ 419
Glasgow	345,625	(i) 193,837	144,530	51,995	735,987	340,891	65,826	78,797	105,492	22,790	172,310	14,377	393,766	+ 12,951
Huddersfield	28,548	6,253	27,821	8,349	70,971	45,349	519	(h) 11,617	11,004	1,545	...	406	24,572	+ 21,296
Hull	(i) 58,137	12,634	31,909	11,622	114,302	48,728	...	16,578	13,883	576	3,117	...	34,154	+ 14,574
Leeds	115,601	40,347	43,609	28,577	228,134	205,805	7,837	47,174	57,773	7,356	11,928	(i) 7,844	132,075	+ 81,567
Leicester	59,052	11,397	22,836	25,322	118,607	51,628	1,660	24,218	13,764	2,801	10,741	1,284	52,808	+ 480
London	H 10,806 E 809,987	3,679 (r) 183,797	4,059 345,138	(m) 11,671 246,328	30,215 1,585,251	def. 8,590 661,791	... 34,032	328,109	408,488	28,197	1,476	(l) 18,079	784,349	− 88,526
N'castle-on-Tyne	71,892	25,519	27,150	22,991	147,552	113,649	4,086	(h) 31,257	41,450	3,618	...	2,805	79,130	+ 38,605
Northampton	7,881	3,169	2,805	4,958	18,814	10,525	506	(h) 3,322	4,422	309	195	(b) 1,083	9,331	+ 1,700
Portsmouth	31,669	11,041	8,901	6,009	57,620	59,371	(a) 12,203	21,593	18,263	1,302	11,714	...	52,872	+ 18,702
Preston	12,350	4,989	9,252	2,995	29,586	16,360	...	3,625	5,038	...	...	1,356	10,019	+ 6,341
Reading	8,635	3,661	4,086	3,597	19,979	16,346	...	6,716	5,062	149	...	...	11,927	+ 4,419
Sheffield	120,296	(i) 31,784	45,385	49,365	246,830	147,701	2,056	31,747	42,504	5,567	30,017	8,014	117,849	+ 31,908
Wellington, N.Z.	57,973	7,775	21,918	17,947	105,613	52,644	2,091	19,865	4,757	...	14,682	...	39,304	+ 15,431

(a) Includes £11,374 balance forward from previous year. (b) Includes £311 loss on omnibus account. (c) Includes £1,611 insurance fund.
(d) Includes reserve. (e) Includes rents for leased lines. (f) Rent of leased lines. (g) Rent of lines and deficit on motor omnibus account.
(h) Including income tax. (i) Includes Army Service Allowance. (j) Includes £692 deficit on railless traction. (k) Includes rents of lines. (l) Including loss on horse traction. (m) Horsing expenses. (n) Transferred to motor omnibus capital account. (o) Includes £1,337 through-running contributions. (p) Includes £407 horse account. (q) Includes National Insurance. (r) Including special charges, £6,053. (s) Includes £2,584 through-running contributions to L.C.C.
(t) Includes balance forward from previous year. (w) Amount apportioned to leased lines. (x) Includes £1,554 profit on motor char-a-banc.
(z) Includes £6,519 rent of leased lines. ‡ £2,950 profit from 3 months' working. * Includes £1,913 spent on renewals.

RECORDS OF ELECTRIC TRAMWAY ACCOUNTS

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Appropriation of Net Surplus.			Receipts per Car Mile.		Operating Expenses per Car Mile.					Per-centage of Operating Expenses to Total Revenue.	Average Operating Expenses per Car Mile (excludi'g Power Cost).	Board of Trade Units.		
	Carried Forward.	Reserve.	Contribution to Rates or Municip'l Funds.	Average Total per Car Mile. d.	Average Traffic per Car Mile. d.	Traffic. d.	General. d.	Repairs and Maintenance. d.	Power. (Price paid) d.	Total. d.	%	d.	Units.	Cost per Unit. d.	Units used per car mile.
Aberdeen ...	...	7,590	3,410	11·06	10·89	2·93	1·53	·99	1·03	6·48	58·54	5·45	2,317,204	·845	1·027
Accrington ...	...	...	1,568	12·64	12·49	3·17	1·18	·94	2·04	7·33	57·99	5·29	949,054	1·23	1·65
Ashton-u-Lyne	47	...	3,050	12·4197	12·0692	2·6622	·8695	1·5788	1·7434	6·8539	55·19	5·1105	640,413	1·25	1·38
Ayr...	...	1,141	...	10·45	9·88	2·26	1·12	1·02	1·32	5·75	55	4·42	421,844	1·39	·94
Birmingham ...	...	31,000	44,972	10·689	10·564	3·080	1·009	1·492	1·913	7·494	70	5·581	24,257,823	1·125	1·70
Blackburn ...	...	...	...	13·81	13·71	3·40	1·25	2·92	1·91	9·48	68·70	7·57	1,739,274	1·3	1·54
Blackpool ...	...	2,553	12,000	18·91	18·74	3·71	1·52	2·17	2·29	9·69	51·28	7·40	1,506,323	1·63	1·40
Bolton	58	...	17,000	11·758	11·656	2·498	·788	1·323	1·721	6·330	53·836	4·610	4,514,010	1·1	1·56
Bradford	...	...	17,200	12·166	11·486	3·204	1·051	2·173	1·948	8·376	73·138	6·428	12,041,279	1	1·924
Brighton	18	...	...	12·240	11·782	3·064	1·464	2·964	1·816	9·308	72·79	7·10	1,676,770	1·2	1·51
Burnley	...	...	7,687	12·079	12·043	3·185	1·035	1·640	2·749	8·609	71·37	5·86	3,894,011	1·24	2·22
Burton-on-Trent	1,163	...	...	9·02	8·28	2·97	·82	1·40	1·72	6·91	76·7	5·08	545,672	1·39	1·08
Bury	...	(k)1,000	5,000	10·26	10·22	2·399	·776	1·253	1·268	5·696	51·82	4·428	2,045,692	1·25	1·26
Chester	...	1,531	...	9·17	8·84	2·27	1·06	·83	1·45	5·61	61	4·17	378,158	1·33	1·08
Chesterfield ...	...	457	...	11·1	10·8	2·54	1·08	2·31	1·73	7·66	68·9	5·93	420,824	1·25	1·38
Colchester ...	...	...	...	9·942	9·668	2·194	·989	1·709	2·006	6·898	69·24	4·892	445,214	1·5	1·34
Croydon	...	230	...	7·464	7·284	2·568	·599	1·254	1·561	5·982	79·53	4·42	2,874,462	1·522	1·027
Darlington ...	...	...	...	8·230	8·068	2·676	·505	1·241	1·251	5·673	68·93	4·422	482,791	1	1·25
Darwen	448	...	...	14·96	14·09	3·20	·92	2·96	2·31	9·39	65·25	7·08	469,939	1·312	1·77
Derby	(n) 75	...	...	E. 10·358 H. 6·077	10·150 5·821	3·438 7·325	·577 ...	1·092 1·099	1·709 ...	6·816 8·424	65·8 138·6	5·107 ...	1,425,112 ...	1·45 ...	1·179 ...
Doncaster ...	...	654	...	10·52	10·37	2·24	·61	2·97	1·90	7·72	73·1	5·82	799,965	1·25	1·51
Dundee	...	12	1,000	12·018	11·716	3·026	1·031	1·639	1·815	7·511	62·49	5·696	2,520,470	1	1·815
East Ham ...	.	...	...	8·73	8·59	2·98	1·08	1·92	1·67	7·65	87·60	5·98	2,385,535	1·062	1·58
Exeter	...	1,724	...	9·456	9·404	2·628	·738	·797	2·059	6·222	65·8	4·163	565,247	1·625	1·27
Gloucester ...	...	...	...	6·84	6·41	2·78	·63	1·14	·71	5·26	77	4·55	470,336	1	·70
Halifax	...	7,483	6,171	11·621	11·514	3·141	·812	1·393	2·225	7·571	65	5·35	4,607,293	1·125	1·98
Ilford	...	...	...	6·891	6·768	2·862	·688	1·048	1·278	5·877	80·9	4·598	1,079,384	1·065	1·175
Ilkeston	...	...	...	7·04	6·87	2·3	·8	1·3	1·4	5·8	83	4·4	372,200	1	1·54
Ipswich	...	...	...	8·552	8·242	3·065	·807	2·002	1·265	7·139	83·47	5·874	676,189	1·25	1·011
Keighley	...	...	...	9·064	8·754	2·664	·761	·890	1·595	5·910	65	4·315	254,636	1·5	1·05
Kilmarnock ...	...	...	...	7·539	7·326	2·57	·61	1·07	1·38	5·63	71·6	4·246	329,577	1·25	1·14
Kirkcaldy ...	33	...	...	9·085	8·864	2·574	·758	1·238	1·558	6·128	67·4	4·57	698,804	1	1·558
Lancaster ...	...	...	...	8·23	7·94	3·14	·71	1·16	2·19	7·20	88	5·02	225,094	1·7	1·29
Leith	...	...	...	9·54	9·24	2·46	·79	1·29	·99	5·53	57·98	4·54	939,737	1·001	·99
Leyton	...	...	...	9·355	9·151	(c) 2·959	1·140	1·815	1·710	7·624	81·338	5·914	3,043,900	1·019	1·678
Lincoln	52	...	...	10·59	10·40	2·34	1·06	1·56	1·41	6·37	60·2	4·96	173,895	1·25	1·128
Liverpool ...	...	...	100.000	12·25	12·02	3·380	1·227	1·460	2·171	8·238	£5·6	6·067	26,007,694	1·14	1·9
Lowestoft ...	...	...	...	9·1	8·8	2·60	·5	1·2	1·8	6·1	67·64	4·3	318,601	1·75	1·03
Maidstone ...	...	...	...	8·51	8·06	2·02	·81	1·34	1·48	5·65	70·07	4·17	371,290	1·25	1·2
Manchester ...	...	...	100,000	11·300	11·123	3·420	1·473	1·069	1·608	7·570	63·47	5·962	29,922,197	1·029	1·562
Nelson	1,980	...	...	12·85	12·78	3·00	·81	1·81	2·51	8·13	63	5·62	255,621	2	1·26
Newport (Mon.)...	...	...	...	10·207	9·950	2·605	1·056	3·239	1·653	8·553	83·74	6·913	1,187,262	1·29	1·23
Nottingham ...	...	6,164	22,500	11·35	11·16	3·06	·93	1·10	1·94	7·03	62·78	5·09	5,806,688	1·25	1·53
Oldham	...	4,901	...	13·422	13·228	3·109	·992	2·570	2·376	9·047	67·40	6·671	3,291,607	1·5	1·585
Perth	...	...	...	8·79	8·31	3·02	·66	·39	1·19	5·26	59	4·07	277,474	1·08	1·09
Plymouth ...	...	...	4,037	12·066	11·450	2·42	1·11	1·29	2·298	7·12	60·83	4·82	1,159,069	1·66	1·38
Pontypridd ...	355	...	...	12·16	11·99	2·78	·78	3·04	1·78	8·38	68·89	6·6	613,719	1·25	1·42
Rawtenstall ...	...	...	...	10·11	9·699	2·40	·99	1·27	1·69	6·35	62·57	4·66	833,714	1·23	1·37
Rochdale... ...	4,284	...	...	11·292	11·134	2·611	·682	1·524	1·654	6·471	56·2	4·817	2,836,062	1·006	1·694
Rotherham ...	E. ... R.T ...	4,287 1,009	750 ...	12·54 10·74	12·52 10·71	2·92 2·44	·87 ·76	2·22 2·68	2·79 1·23	8·80 7·11	70·15 66·20	6·01 5·88	1,731,184 120,303	1·375 1·375	2·03 1·07
Salford	...	...	22,000	10·501	10 499	3·059	·916	970	1·936	6·881	65	4·945	9,812,392	1·23	1·606
Southampton ...	1,282	...	5,134	...	...	...	...	...	...	...	...	...	...	...	...
Southend-on-Sea	2,514	1,000	6,000	13·14	12·97	3·03	·85	1·33	2·33	7·54	57·35	5·21	848,538	1·75	1·33
Southport ...	...	..	...	9·763	9·528	2·462	1·101	1·607	1·554	6·725	68·8	5·171	468,554	1·5	1·011
South Shields ...	(d) 500	4,907	1,700	10·244	10·087	2·362	·993	·971	1·710	6·036	58·92	4·326	1,105,203	1·388	1·231
Stalybridge, &c.	...	..	...	8·084	8·056	2·755	1·079	1·600	1·453	6·887	83·15	5·269	1,803,063	·9	1·614
Stockport ..	..	250	12,250	10·958	10·745	2·388	·738	1·618	·961	5·705	47·94	4·744	...	...	...
Sunderland ...	...	...	5,000	12·210	12·148	3·198	·905	·786	1·820	6·709	54·75	4·8	1,802,694	1·5	1·21
Swindon	...	...	...	9·62	9·24	3·06	·89	1·65	1·99	7·59	79·29	5·60	277,568	1·6	1·24
Wallasey ...	1,443	3,000	7,750	11·844	11·739	3·287	·891	1·211	2·138	7·527	63·5	5·38	1,971,378	1·4	1·52
Walsall	2,479	...	1,000	11·353	11·094	2·834	1·108	1·437	1·888	7·267	64·012	5·379	858 649	1·68	1·164
Walthamstow ...	...	...	...	8·09	7·94	3·05	·66	1·53	1·76	7·00	86·6	5·24	1,495,460	1·375	1·28
Warrington ...	739	...	2,500	12·521	12·246	3·161	·966	2·096	1·798	8·021	68·273	6·223	545,817	1·5	1·199
West Ham ...	...	...	..	9·27	9·075	3·417	1·154	2·137	1·353	8·061	88	6·708	6,974,894	·75	1·85
West Hartlepool	...	3,018	...	9·77	9·52	2·39	·79	1·49	1·13	5·80	59	4·67	680,972	·78	1·42
Wigan	4,690	...	...	12·77	12·46	2·655	·856	1·862	1·761	7·11	56·07	5·35	2,216,740	1 5/16	1·476
Wolverhampton	...	...	3,744	11·239	11·091	2·648	1·267	1·746	1·463	7·124	62·5	5·661	1,712,796	1	1·45
Yarmouth (Gt.)...	...	...	...	8·738	8·563	2·583	·616	1·016	1·649	5·864	68·48	4·215	758,296	1·56	1·052
York	...	2,524	...	9·08	8·86	2·95	·69	·66	1·78	6·08	67	4·30	1,009,827	1·25	1·43

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

									*					Works Cost.	
Belfast	...	...	12,185	10·08	9·93	2·83	·64	1·32	1·07	5·86	58·07	4·79	10,439,797	·658	1·39
Bexley	...	...	...	11·13	12·3	2·53	·85	2·82	·68	6·88	71·1	6·20	487,110	·827	1·66
Birkenhead ...	...	...	...	12·643	12·496	3·140	·991	2·170	1·336	7·637	60·33	6·30	2,672,599	·65	2·054
Bournemouth ...	...	2,000	...	12·83	12·76	2·95	1·02	1·26	(b) 1·99	7·22	56·21	5·23	3,245,277	·67	1·65
Cardiff	845	2,047	9,600	11·65	11·45	3·563	·900	1·468	·850	6·781	60	5·931	5,073,942	·488	1·71
Coventry ...	419	...	...	9·271	9·115	2·742	·953	1·694	·819	6·208	66·9	5·389	1,652,029	·544	1·47
Glasgow	...	...	12,951	10·674	10·612	3·426	1·922	1·432	·515	7·295	59·87	6·266	33,848,947	·366	1·40
Huddersfield ...	6,662	14,634	...	11·34	10·98	2·78	·61	2·72	·81	6·92	61·01	6·00	4,881,338	·42	1·94
Hull	...	4,574	10,000	8·61	8·53	2·87	·66	1·68	·61	5·82	67·58	5·26	6,352,263	·44	1·40
Leeds	...	...	81,567	10·936	10·834	2·914	1·016	1·099	·720	5·749	52·57	5·029	18,862,847	·668	1·918
Leicester	...	...	480	9·875	8·682	3·425	·661	1·325	1·469	6·880	69	5·411	7,540,856	·420	1·82
London	...	...	...	E. 9·21 H. 8·15	8·94 7·97	3·32 4·07	·76 1·39	1·41 1·53	1·01 4·40	6·50 11·39	70·55 139·72	5·49 11·39	154,048,461 ...	·601 ...	2·63 ...
N'castle-on-Tyne	...	25,135	13,470	11·709	11·253	3·222	1·144	1·217	1·031	6·614	54·96	5·583	10,231,454	·421	1·922
Northampton ...	...	1,200	500	10·69	10·39	2·87	1·15	1·03	1·80	6·85	64	5·05	966,282	1·23	1·47
Portsmouth ...	10,702	(i) 3,000	5,000	11·204	11·030	3·033	1·057	·852	·576	5·518	49·25	4·942	3,056,720	·521	1·103
Preston	...	5,041	1,300	10·75	10·54	2·890	1·168	2·164	·700	6·922	64·40	6·222	1,765,250	·407	1·49
Reading	...	2,529	1,890	9·261	8·996	2·201	·933	1·042	·917	5·093	55	4·18	1,170,173	·737	1·12
Sheffield	7,032	2,000	22.876	10·747	10·606	3·277	·866	1·236	1·345	6·724	61·116	5·379	18,329,775	·646	1·979
Wellington, N.Z.	15,431	...	...	16·309	16·189	5·974	·801	2·259	1·850	10·884	65·86	9·034	4,769.149	·906	2·05

* The figures given under "Power" in Table II. include actual works costs only. H—Horse lines. E—Electric trolley system. (b) Including current supplied by Bournemouth and Poole Supply Company. (c) Horse account ·054d. (d) Accident, insurance, and compensation fund. (f) Insurance fund. (i) Including Insurance. (k) Insurance. (n) Remainder expended in paying capital expenditure not borrowed. (t) Amounts for 15 months.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Population Served.	Car Mileage.	Passengers Carried.	Traffic Records. Passengers Carried per Car Mile.	Average Fare per Passenger. d.	Average Journeys per Head of Populat'n per Annum.	Average Car Miles per Day per Car.	Traffic Revenue per Mile of Single Track. £	Average Traffic Revenue per Annum per Head of Populat'n Served.	Operating Expenses per Passenger. d.	Average Distance of 1d. Fare. Miles.	Average Fare Charged per Mile. d.	Average Speed per Hour. Miles.	Average Total Car Hours per Day.	Average Number of Cars in Use Daily.	Number of Cars in Stock.
Aberdeen ...	165.000	1,909 009	24,048,816	12·59	·86	145·8	90	3,121	10/6	·514	...	·57	7·6	812	63	83
Accrington ...	45.525	573.536	4,998,979	8·72	1·377	109·8	105	3,033	13 1	·84	1·07	·929	7·5	250	18	27
Ashton-u-L.	50.000	464.160	5,053,701	10·888	·648	173·09	106	2,851	9/4	·368	1·223	·81	8	190	12	25
Ayr	33.000	444.802	4,238,494	9·52	1·04	128	102	1,953	11·1	·606	1·25	·75	8	168	12	22
Birmingham	868,430	14,268.24	146,930,986	10·29	1·03	169	79·77	5,482	14 5	·904	2·	·427	7·87	10·16	500	550
Blackburn ...	200.000	1,121.769	12,223,569	10·89	1·28	61·12	105	2,528	6·6	·902	1·25	·76	7·50	434	31	61
Blackpool ...	67,500	1,075.943	14,289,802	13	1·41	211·7	86·7	4,524	24 9	·73	...	...	8	..	34	78
Bolton ...	221,000	2,886.180	31,370,166	10·86	1·066	141·49	124·07	2,920	12/8	·582	1·553	·633	7·25	980	70	112
Bradford ...	370,000	6,255.878	67,675,166	10·816	1·058	182	113	2,792	16 2	·819	1·67	·531	7·3	2,340·5	151	248
Brighton ...	133,936	1,108.352	11,837,828	11	1·10	88·38	76·08	3,165	8/1½	·83	1·27	·757	6·41	512	32	53
Burnley ...	175,000	1,754.811	17,668,834	10·07	1·18	101	120	3,971	10/1	·85	1·25	·83	7	874	46	67
Burton ...	48,000	439.248	3,339,184	7·60	1·058	70	...	1,782	6 3	·91	1·505	·58	7·5	...	...	20
Bury	128,202	1,613.357	15,513,264	9	1·07	121·47	99·73	1,904	10 9	·554	1·30	·77	8·54	...	...	54
Chester ...	39,028	347.260	3,217,899	9·26	·95	82·45	95	1,987	6·7	·606	1·27	·8	7	150·6	10·04	18
Chesterfield	50.000	304.376	2,950,774	9·7	1·1	76	122	2,668	5 5	·78	1·38	·75	7·33	126	7	17
Colchester ...	65 000	332.963	2,434,786	7·31	1·32	37·46	86·80	1,689	4 1	·94	·85	·96	6·77	147·14	10·51	18
Croydon ...	178,094	2,801.302	19,227,878	6·87	1·06	107·96	129	4,818	9 10	·871	2·05	·50	8·14	942·23	59	75
Darlington ...	60,000	385.999	4,140,269	10·7	·752	69	96·1	1,460	4/4	·53	1·219	·45	6·66	151·25	11	18
Darwen ...	...	266.912	2,993,697	11·22	1·25	...	...	2,182	...	·88			...	...	...	...
Derby ...	124,000	E 1,208.880	12,136,148	10·039	1·011	97·88	...	2,398	8/3	·67	1·44	·75	6·375	...	...	50
		H. 17.710	110.231	6·224	·935			...	...	1·35	1	1	..	...	...	3
Doncaster ...	60,000	529.122	5,747,273	10·86	·955	95·79	93·9	1,798	7/7	·711	1·25	·76	7·5	239	18	32
Dundee ...	165,000	1,387.980	19,042,344	13·71	·853	115	...	2,387	8 2	·547	2	·50	7·3	...	...	68
East Ham ...	145.000	1,510.251	16,671,505	11·04	·78	115	150	3,704	7/1	·69	1·635	·634	7	216	32	45
Exeter ...	48.660	446.338	4,320,459	9·68	·97	88·8	82·125	2,498	7/2	·642	1·1	·902	5·76	228	16	20
Gloucester ...	53.972	624.402	4,358,510	7	·92	81	90·60	1,113	6 2	·75	1·5	·65	7·08	250·8	19	30
Halifax ...	176.000	2,330.104	20,707,071	8·89	1·27	118	81·76	2,015	12·8	·818	1·314	·82	7·23	883·74	78	101
Ilford ...	84.000	899.515	8,036,552	9·70	·758	95·7	...	2.256	5·7	·62	1·543	·69	8	...	..	26
Ilkeston ...	32,000	241.548	1,746,382	7·2	·95	...	90	1.942	52 8	·8	1·50	·5	7	101	7	13
Ipswich ...	75,681	668.650	5,715,035	8·54	·975	75·51	65·5	1,559	6/1	·84	1·53	·693	5·51	332·80	20·80	36
Keighley ...	43.000	242.500	3,099,272	12·8	·68	72·06	55·35	1,447	4 1	·462	2·22	·45	6·87	126	7	12
Kilmarnock	36.000	297.743	2,482,034	8·33	·875	68·94	93·12	1,632	5/	·675	1·13	·86	7·22	109·14	8·76	14
Kirkcaldy ...	39.600	448.469	5,492,120	12·24	·723	138	49	1,882	8 4	·5	1·522	·64	7	158	17	22
Lancaster ...	41.786	174.752	1,603,321	9·17	·865	38·37	76	1,204	2·9	·785	1·71	·5	8	87·22	6·23	12
Leith ...	110,400	949.322	10,244,235	10·79	·86	92 8	125	2,031	6 8	·512	1·32	·72	8·3	314	21	37
Leyton ...	124,735	1,813,462	17,472,882	9·64	·950	140	120	3,820	11/1	·791	1·77	·95	8·25	14·5	40·0375	60
Lincoln ...	20.000	148.440	1,713,542	11·5	·89	85·67	59·3	2,169	6·5	·552	1·75	·428	7	72	4	8
Liverpool ...	840.000	13,657.888	145,656,374	10·67	1·127	173·40	89·09	5,516	16/3	·772	2·514	·39	7·75	5.040	420	596
Lowestoft ...	35.000	307.838	2,706,348	8	1·07	77·32	70·25	2,787	6/6	·703	1·5	·7	5·75	192	12	19
Maidstone ...	25.000	309.256	2,407,769	7·783	1·036	96·312	85	1,476	8.4	·725	1	1	6·8	133	12	19
Manchester ...	957,500	19,155.051	202,768,420	10·6	1·06	212	93·5	4.835	18/7	·717	2·514	...	7·75	7·2	561	683
Nelson ...	45.000	202.781	2,949,784	14·55	·88	65·55	92·59	2,796	4·9	·56	1	1	5·50	108	6	11
Newport ...	89.400	968.524	9,155,356	9·45	1·08	102·41	100	2,798	9/-	·904	1·164	·898	...	...	34	44
Nottingham	264,000	3.789.857	41,210,964	10·87	1·02	156	95·28	3,984	13/4	·646	1·75	·442	6·92	...	109	155
Oldham ...	180,000	2,077.104	22,773,108	10·963	1·19	126·52	121	3,136	12/8	·825	1·11	·884	7	846	47	92
Perth	35.900	252.940	1,813,228	7·16	1·15	50·5	96·25	1.298	4.7	·73	..	...	6·25	120	8	12
Plymouth ...	112.000	838.142	9 333.087	11·13	1·027	83·33	...	2.666	7/2	·639		...	...	...	...	42
Pontypridd ...	40.000	432.006	5,047,168	11·68	1·02	126	81·2	2,509	10/9	·71	1·25	·51	6·5	221	17	26
Rawtenstall	40,000	605.485	4,869,792	8·04	1·21	122	111	1,540	12/3	·79	1·121	·88	8·50	247·5	15	24
Rochdale ...	130.000	1,772.546	14,286,607	8·06	1·387	109·90	110·30	2,085	11/11	·78	1·07	·90	7·33	660	44	69
Rotherham ...	64,000	E 852.639	9,874,231	11·58	1·08	154·3	...	3,701	13.9	·76	...	...	...	...	...	...
	...	RT 128.685	471,690	3·67	2·72	...	...	...	...	1·92	...	...	...	...	...	...
Salford ...	350.000	6,235.278	53,124,546	8·52	1·227	)51	108	3,646	15/7	·88	2·20	·46	7·916	2,054	158	200
Southampt'n	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Southend ...	78.000	637.366	7,581,104	11·89	1·09	97·2	87	4,708	8/10	·634	1·41	·76	6·5	357	21	31
Southport ...	31,312	463.262	4,663,579	10·067	·94	148·62	98	1,710	11/5	·677	1·6	·62	6·65	825	15	26
So'th Shields	111.357	898.015	10,005,164	11·414	·905	90	110	3,677	6·9	·54	3·1	·38	8·06	338	20	35
Stalybridge	94.091	1,116.936	8,406,915	7·706	1·06	89·3	...	1,353	8/-	·905	1·22	·72	6·8	.	...	60
Stockport	120.000	1,490.116	...	...	...	...	...	2,356	11/2	...	...	..	...	...	...	...
Sunderland	170.000	1,486.201	18,619,364	13·2	·97	109·5	78·3	3,696	8/10	·536	1·34	·68	7	688	43	70
Swindon ...	53.000	223.383	2,392,470	10·71	·859	45·14	75	1,955	3/4	·709	1·2	·85	6	...		12
Wallasey ...	84.500	1,291.046	13,105,204	10·15	1·15	155	99·6	3.163	14/11	1	1·89	·54	7	525	48	61
Walsall ...	100.000	720.634	6,752,727	9·371	1·184	68	94	1.905	6/7	·775	1·24	·79	7	315	21	39
Walth'mst'w	130.000	1,166.027	12,579,852	10·788	·736	96·76	95	2,883	5/11	·65	1·18	·86	7·5	430	37	38
Warrington	86.000	455.304	6,134,545	13·473	·909	71·332	102·423	2,406	5·5	·59	1·246	·803	6·401	194·86	12·179	21
West Ham	296.600	3,756.354	41,152,502	10·95	·828	138	92	4.726	9·7	·73	1·80	·51	7·75	1.235	95	118
W. Hartlep'l	90.000	479.382	4,261,917	8·89	1·07	47	94	2,163	4 3	·65	1·262	·94	7	203	14	26
Wigan ...	200.000	1,500.846	14,235,274	9·52	1·308	71·47	93·45	2,525	7/9	·74	1·15	·88	7·4	605	44	67
Wolverh'ton	135,000	1,181.309	12,236,785	10·359	1·06	90·64	89	2,539	8/1	·687	1·25	·879	6·85	651·6	36·2	52
Yarmouth ...	56.000	720.702	4,930,728	6·84	1·231	88·05	79	1.746	9/2	·857	1·25	·76	7	375	25	35
York	82,600	707.370	5,946,843	8·41	1·05	72	108	2,193	6·2	·73	1·33	·789	8	270	18	31

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast ...	390.000	6,432.600	62,340,269	9·74	1·02	159	128	2,689	13/8	·60	1·96	·43	8·75	2.014	241	290
Bexley ...	16,500	316.970	2,270,070	7·16	1·55	133	126	2,922	19/10	1·24	1·59	·63	9·5	179	11	16
Birkenhead	135,740	1,300.717	15,167,958	11·66	1·071	111·74	69·98	2,811	9/11	·71	1·39	·66	6·84	520·61	50·94	65
Bournem'uth	120,000	1,962.352	17,182,844	8·76	1·46	143	95	3,505	17/5	·824	1·19	·87	6·8	1,140	60	81
Cardiff ...	182,729	2,966.230	31,122,962	10·49	1·09	170	98·5	4,447	15·6	·65	1·44	·736	7·5	1.264	79	130
Coventry ...	135,000	1,125.705	8,407,719	7·5	1·22	62	66	2,714	6·4	·831	1·18	·866	6·4	476	40	46
Glasgow ...	1,150,000	24,214.460	336,260,758	13·887	·764	292·4	105·61	5,404	18 7	·488	2·31	·44	8·11	8.974·78	628·20	856
Huddersfield	160.000	(a) 2,461,107	22,616,710	9·21	1·19	174	82	3,634	14·1	·766	1·35	·71	7·62	885·28	55·33	96
Hull	291.118	4.551,145	52,087,770	11·44	·745	178·92	123·43	4,879	11/1	·52	2·75	·364	9	1,565·60	97·85	180
Leeds ...	525,000	9.522,737	95,633,268	10·04	1·075	182	115·43	5,747	16/4	(b) ·884	1·93	·539	7·54	3,465	230	345
Leicester ...	232,644	4.137,262	37,914,773	9·146	·947	163	108·35	4,045	12/10	·751	2·18	·45	8	1,451	...	160
London ...	...	E58,572,356	516,338,859	8·82	1·01	...	120·18	7,866	...	·73	...	...	9·05	17,728·8	1,535	1,722
		H 636.933	,613,781	10·38	·77	...	77·12	1,519	...	1·09	...	...	5·85	203·14	23	56
Newcastle ...	300.000	5,353.875	57,840,666	10·81	1·071	193	100	3,992	16/9	·612	1·58	·633	7·5	...	133	200
Northampt'n	91,500	638.809	7,303,863	11·09	·94	82·73	...	3,102	6 4	·617	1·34	·7	...	...	...	26
Portsmouth	245.827	2,506.058	26,266,342	10·481	1·052	106·85	90·34	3,325	9/5	·527	1·66	·62	7	1,140	76	100
Preston ...	120.000	1,025.738	10,340,688	10·08	1·04	86·17	132	2,652	7·7	·764	1·01	·95	7·36	404·7	21·3	33
Reading ...	76,500	941.303	8,865,128	9·42	·97	116	110·5	2,680	9·2	·54	1·59	·68	7·5	352	26	36
Sheffield ...	485.228	8.810.252	107.023,195	12·147	·878	220	108·86	4,950	16 2	·553	2·917	·371	...	3,215·05	221·728	339
Wellington	70.000	2,328,849	24.565,376	11·28	1·43	359	85	4.708	44/10	1·031	1·125	·89	7·59	840	75	92

E—Electric trolley system. H—Horse lines. (a) Including 9,395 miles coal haulage. (b) Total expenses per passenger.

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Birmingham District Power and Traction Company.—At the annual meeting on June 21 it was stated that the Birmingham and Midland Motor Omnibus Company now owned and controlled all of the Power and Traction Company's omnibus interests around Birmingham. A sum of £2,000 had been added to reserve, bringing it up to £16,493, so that the total reserves and funds amounted to £67,000. Having regard to the effect of the war, the net result for the year was satisfactory. They had maintained the dividend on the ordinary shares at 3½ per cent., besides placing £2,000 to reserve and carrying forward £960. They received a first dividend on the preference shares in the Birmingham and Midland Motor Omnibus Company, whose shareholders had cancelled all arrears of dividend on the preference shares, and a dividend of 5 per cent. for 1914 was declared and paid. The rate had been increased from 5 to 6 per cent.

War Temporarily Affects Rangoon Tramways Traffic.—When war was declared the Burmese were led to believe that the Germans were besieging Rangoon by sea and air, and emphasis was given to these reports by the operations of the "Emden." Consequently the agricultural population was deterred from coming to Rangoon, and also from attending the festivals. The traffic suffered a heavy set-back, but since last March confidence was being gradually regained. Speaking at the shareholders' annual meeting in London, Sir Frederick Fryer (chairman) added that the management believed that traffic would again come up to reasonable expectations. After providing for debenture and preference interest, £8,076 was available as dividend, against £11,674 the previous year. The directors recommended the payment of a dividend at the rate of 3 per cent., leaving £2,765 to be carried forward. Had conditions remained normal, a record year was anticipated.

DIVIDENDS.

The following dividends have been announced by the "London Underground" group :—

London General Omnibus.—Dividend of 6 per cent., free of tax, on the ordinary shares for the half-year to June 30. In August, 1914, 8 per cent. was paid.

Underground Electric Railways.—Interest on the 6 per cent. first cumulative income debenture stock will be paid on and after September 1, less tax, at the rate of 6 per cent. per annum, and Coupon No. 15 of the 6 per cent. income bonds will be paid, free of British income-tax, at the rate of 6 per cent. per annum on the same date.

Central London Railway.—Interim dividend for the first half of the year on the undivided ordinary stock at the rate of £3 per cent. per annum, and on the preferred ordinary stock at the rate of £4 per cent. per annum, the same as a year ago.

Metropolitan District Railway.—For the past half-year at the rate of 3 per cent. per annum on the 2nd preference, the same as a year ago.

London Electric Railway.—For the past half-year at the rate of 1 per cent. per annum, the same as a year ago, on the ordinary shares.

Metropolitan Surplus Lands.—At the rate of 2½ per cent. per annum for the past half-year, the same as a year ago.

City and South London Railway.—Dividend for the past year on the preference stocks of 1891, 1896, 1901, and 1903 at the rate of 5 per cent. per annum, the same as a year ago.

Metropolitan Railway.—At the rate of 1 per cent. per annum for the past half-year, against a rate of 1½ per cent. per annum a year ago.

Melbourne Tramway and Omnibus.—A bonus of 2s. per share is to be paid from profits for the year ended June 30 last.

Walter Scott, Limited.—7½ per cent. on the ordinary shares for the year to June 30.

Bristol Tramways and Carriage Company.—At the rate of 4 per cent. per annum for the half-year ended June 30.

THE GENERAL ELECTRIC COMPANY.

Great Output of War Material.

The ordinary general meeting of the General Electric Company, Limited, was held on July 9 in Cannon Street Hotel, London, Mr. H. Hirst, chairman and managing director, presiding.

The Chairman, in moving the adoption of the report and accounts (which proposed a dividend of 10 per cent. on the ordinary shares), reviewed some of the experiences of the company since the outbreak of the war, and said that about 1,000 of the employees were serving with His Majesty's Forces. Having detailed the generous terms arranged by the directors for employees who enlisted, he referred to Government orders for war purposes. The value of these down to the end of March amounted to half a million sterling. Among these productions were searchlight carbons, signalling and wireless apparatus, incandescent lamps; power, lighting, and ventilating plant for dockyards and battleships; motors, dynamos, and every kind of electrical equipment for various units, hospitals, munition works, etc.; field telephones and batteries, targets, exploders, and shells for both services. It was a matter of great satisfaction that the board's determination to maintain single-handed certain industries for patriotic reasons in the face of foreign competition had at last been rewarded by the knowledge that they had proved of vital importance to the country. The company was in so strong a position that should there be a reduction of profits it would quickly be able to make good after victory had been achieved. The Pirelli-General cable works were completed, and had started manufacturing for certain Government contracts. The erection of the company's Kingsway building had been suspended for the moment, as it seemed to the board wrong at this juncture to pursue any scheme which did not add to national production or efficiency. They had invested £100,000 in the first War Loan, and that was now converted into new War Loan. They had also applied for £100,000 of the latter, making a total holding of £200,000.

Mr. E. G. Byng (vice-chairman) seconded the motion, which was unanimously adopted, and a hearty vote of thanks was awarded to the directors and staff for the successful way in which they had conducted the business, appreciation being expressed of their policy during the time of war.

PERSONAL.

Captain C. Brunner, the chairman of Foden's, Limited, is serving with the forces.

Mr. R. H. Balfour has been appointed chief engineer to Montreal Electrical Commission.

Mr. J. T. Middleham, of Steel Bank, Sheffield, has been appointed a director of Hadfields, Limited.

Sir Charles Petrie and Mr. E. Davis have been re-elected as directors of Singapore Electric Tramways, Limited.

Mr. L. E. Harvey, Ilford tramways manager, has been given permission to join the Volunteer Munitions Brigade.

Mr. W. E. Lloyd has resigned his appointment as manager and secretary of the electricity works of Bacup Council.

Mr. E. R. Peacock has been appointed president of the Barcelona Traction, Light and Power Company, in succession to the late Dr. Pearson.

Mr. Gilbert Mann, of Birkenhead, has been appointed car shed superintendent of Derby Corporation Tramways at a salary of £150 per annum.

Mr. J. W. Spark, electrical engineer for Plymouth and Devonport Councils, has been appointed borough electrical engineer at West Hartlepool.

Mr. C. J. Spencer, general manager, Bradford Corporation Tramways, has been appointed transport officer on the staff of Bradford City Volunteer Corps.

Mr. H. G. Pike has been appointed manager of a new depot which the Scottish Motor Traction Company have established in West Graham Street, Glasgow.

Mr. R. Jones, assistant electrical engineer, Dartford Urban Council, has received an increase of £30 in his salary, payable in annual increments of £10.

Mr. A. T. Lambert, general manager and electrical engineer, Maidstone Corporation Tramways, has been granted an annual increase of £25 in his salary.

Mr. J. H. H. Niblett, who is in the service of the Bath Electric Tramways Company, has passed the June Associateship examination of the Chartered Institute of Secretaries.

Mr. C. Burgess, general manager and engineer, West Hartlepool Corporation Tramways, has had his salary increased by the sum of £25, with a further addition of £25 next year.

Sir John Lindsay, Town Clerk of Glasgow, has been presented by the members and the officials of the Corporation with the Court dress in recognition of the knighthood recently conferred by the King.

Lieut. P. H. di Marco, A.I.E.E., formerly engineer and manager of the Barnsley and District Electric Traction Company, Limited, has been promoted to a captaincy, his promotion being recently gazetted.

Mr. Stanley Kettle, chief assistant to Musselburgh and District Electric Light and Traction Company, has been appointed assistant engineer and depot superintendent to Sunderland and District Electric Tramways Company.

Private W. Lonsdale, the ex-Leeds tramcar conductor, who was sentenced to death for striking in self-defence at one of his guards at Doberitz Camp, Berlin, has written to his wife. He states that the sentence has been reduced to fifteen years' imprisonment.

Sergeant G. H. Rastall and Corporal E. Mann, who were motormen on the Manchester tramways when they were recalled to the army last August, have been awarded the distinguished conduct medal. They are serving with the King's Own Royal Lancaster Regiment in France.

Mr. G. L. Preece has resigned his charge of the Manchester office of Messrs. Bruce, Peebles and Company, Limited, to take a commission in the Lancashire Fusiliers. Mr. E. W. Browne, the company's representative in Birmingham, will act as manager in Manchester during Mr. Preece's absence.

Lieutenant Briggs, who has been given a commission in the Coldstream Guards, before the war was an employee of Coventry Tramways Department. Councillor Pugh, chairman of the Tramways Committee, has tendered congratulations to the lieutenant upon being selected to receive a commission.

Mr. J. C. Whiteley, who has been appointed engineer and manager of the South Shields Corporation Tramways, has been presented with a fumed oak rolled top desk, by the staff and employees of the Chatham and District Light Railway Company. Mr. W. Jensen, the general manager, made the presentation.

Mr. Fergusson, local manager, Dartford Tramways Company, who recently underwent a serious operation, has now resumed the duties which he has undertaken since Mr. D. N. R. Bruce, the general manager and engineer, joined the forces. Mr. Saunders, the operating manager, who has been laid by with a fractured arm, has also returned to duty.

Sub-Lieut. A. R. Courtenay is the latest officer recruit from the General Electric Company, Limited, several of whose officers and men have already won distinction in the field. Mr. Courtenay was the acting manager of the G.E.C. publication department. He was

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gazetted on May 20 sub-lieutenant in the Royal Naval Air Service, Armoured Car Aeroplane Support (Royal Naval Volunteer Reserve).

Mr. J. Shepherd, who for the past thirteen years was with the tramway department of London County Council, has entered into partnership with Mr. T. S. Watney, consulting engineer, Greek Street Chambers, Park Row, Leeds. For eight years Mr. Shepherd was the Council's chief assistant electrical engineer, and during the past four or five years he has had entire charge of the electrical work.

Mr. Owen Silvers, deputy manager, Wolverhampton tramways, at a meeting of the Corporation, was complimented by Alderman Craddock on the successful manner in which he had carried on the undertaking during the illness of Mr. Luntley, and with sixty men away at the war. The Council adopted a recommendation by the Tramways Committee for payment of an honorarium of £50 to Mr. Silvers.

Mr. R. C. Bullough, general manager, Colchester Corporation Tramways, has been granted a gratuity of £25 in recognition "of the great increase of responsibility and work which he has been called upon to undertake since the commencement of the war, and the manner in which he has so successfully contended with the numerous disadvantages consequent upon so many of the men employed upon the system having joined His Majesty's Forces."

Mr. G. R. C. Conway, on relinquishing the appointment of chief engineer to the British Columbia Electric Railway Company, has been appointed consulting engineer. He has opened an office as a consultant in Toronto. Mr. Conway, who was appointed to his late position in December, 1910, has designed and constructed many important works for the company. For eight years he was resident engineer for the city of Aberdeen, leaving Scotland to become chief engineer to the Monterey Railway, Light and Power Company, Mexico.

Rangoon Tramways Directorate.—At the annual meeting the shareholders re-elected Mr. J. Halliday and confirmed the appointment of Mr. J. Glynn, of Liverpool, as directors. To fill vacancies created by the resignation of Mr. F. Tobin and Mr. J. Taylor, the meeting appointed Colonel A. C. de Joly de Lotbiniere, R.E., and Mr. H. D. Dickie, of Liverpool. Colonel de Lotbiniere filled the position of electrical adviser to the Government of India and carried through the Mysore and Kashmir schemes. His services are now being temporarily utilised by the War Office.

Honorary Appointments.—Mr. A. C. Cramb, borough electrical engineer, Croydon, has been nominated by the Board of Management of the Metropolitan Munitions Committee to serve as honorary district manager of the Croydon area. Mr. A. H. Seabrook, general manager, Marylebone electric supply undertaking, has been asked to act as chairman of an operating sub-committee of the committee, and also as supervisor of various works in the London district. Mr. C. N. Russell, borough electrical engineer, Shoreditch, has been nominated as manager of the eastern district.

Mr. H. T. Wakelam, county engineer for Middlesex, was formally installed as President of the Institution of Municipal and County Engineers at the 42nd annual meeting. Mr. Wakelam has been in the service of Middlesex County Council for seventeen years, and among the many important undertakings he has carried out the laying of the tramways owned by the Council may be mentioned. At present he is engaged upon the construction of the new Great West Road out of London. He served as an officer in the old 6th Lancashire Volunteer Artillery and the 1st Herefordshire Rifles.

Private A. Hotz, 1st East Surrey Regiment, late of the Rugby staff of the British Thomson-Houston Company, has been decorated with a distinguished conduct medal for conspicuous gallantry on Hill 60. He placed himself in front of a communication trench occupied by the enemy, and, on the Germans advancing, attacked them with hand grenades, putting them to flight. Before the war Private Hotz was employed in the construction department of the British Thomson-Houston Company, and the members of the staff are very much pleased with the winning of this reward for gallantry by one of their number.

Tramways Sub-Committees of the London County Council.—The Accounts, Stores, and General Sub-Committee and the Tramways Management and Construction Sub-Committee have been discontinued, and the Highways Committee have appointed a General Sub-Committee for the purpose for which the two sub-committees were appointed. The General Sub-Committee consists of thirteen members, in addition to ex-officio members, and includes Messrs. H. E. A. Cotton, D. Davies, A. O. Goodrich, H. H. Gordon, W. Haydon, W. Hunt, H. Marks, A. C. Rawson, A. H. Scott, W. J. Squires, S. J. Thomas, H. Ward, and A. W. Yeo.

Mr. A. L. C. Fell, chief officer of the London County Council Tramways, at the invitation of the Directors of Supplies and Transport, War Office, attended as the representative of the London County Council a meeting held some time ago to consider the question of improving railway, tramway, and omnibus services to and from the Woolwich Arsenal. Mr. Fell also represented the Council at the National Conference convened by the Institution of Electrical Engineers, consisting of representatives of the gas and electrical industries, to consider the best course for bringing under the attention of the Government the existing state of affairs with regard to the coal supply.

Mr. T. R. Whitehead, engineer and general manager, Coventry Corporation Tramways, and his staff have been congratulated upon their excellent work during the past year by Councillor Pugh, chairman of the Tramways Committee. In presenting the third annual report to the Council, the chairman said they had successfully come through an exceedingly difficult period in an undertaking which, apart from war difficulties, would continue to present special problems of administration. Councillor Wale, the vice-chairman, added that absence of friction was due to the tact and impartiality of Mr. Whitehead. The Council were to be congratulated on having such a management.

RAILWAY OFFICERS AND STAFF.

Mr. Henry Wright has been appointed chief cashier to the North Eastern Railway Company.

Colonel Bonham-Carter, secretary of the Madras and Southern Mahratta Railway, is engaged upon staff duties at the War Office.

Major Maguiae, agent of the Madras and Southern Mahratta Railway, is serving as a railway staff officer at the British Army headquarters on the Continent.

Lieut.-Colonel William Forbes, general manager, London, Brighton, and South Coast Railway, received the honour of knighthood from the King at Buckingham Palace on July 12.

Mr. M. C. Tait has succeeded Mr. C. de J. Andrewes as chief solicitor to the London and North Western Railway. Mr. Tait has held the appointment of assistant solicitor since 1903.

The Hon. B. Eastwood, chief accountant and acting general manager of the Uganda Railway, has been appointed by the Colonial Office to the position of general manager, in place of Mr. H. B. Taylor, resigned.

Mr. J. Argyle, northern divisional engineer, Midland Railway, has been presented with gifts for himself and his wife on the occasion of his retirement, after forty-five years' service. He is now giving his services at munition works.

Midland Railway Engineering Staff.—Mr. H. Powell Miles, southern divisional engineer, Midland Railway, has been appointed divisional engineer of the new central division, while Mr. F. J. Greasley, of the chief engineer's staff, has been appointed engineer of the southern division.

Mr. J. M. Eddy left England in July to become assistant general manager of the Buenos Ayres Great Southern Railway. Since he joined the staff of the London and North Western Railway in 1898 he has held the following positions:—Assistant at Euston headquarters, assistant rolling stock superintendent, rolling stock superintendent, and mineral traffic manager.

Lieutenant H. T. Rendell, formerly of the G.W.R. motor car department at Slough, has been promoted to the rank of captain. He has been at the front since the commencement of the war, and was recently transferred to the headquarters staff of the Director of Transport, and appointed an inspector of the mechanical transport of the various units of the British Army in the field.

Sir Gilbert Claughton, chairman of the London and North Western Railway, and Mr. J. H. Thomas, M.P., of the National Railwaymen's Union, are members of a committee appointed by the Government to inquire into and report what saving in public expenditure can, in view of the necessities created by the war, be effected in civil departments without detriment to the interests of the State.

Sir Sam Fay, general manager of the Great Central Railway, was among the representatives of employers who attended the conference at which the Chancellor of the Exchequer explained the opportunity given for employees to invest in the new War Loan. Sir Sam announced that the Railway Executive Committee would place at the Government's disposal all the facilities necessary to enable men to invest.

Mr. G. J. Whitelaw, chief accountant of the Great Western Railway, has been entertained at dinner by his late colleagues of the Accountants' Committee upon his resignation from the chairmanship of that body. He was also presented with a gold watch. Mr. Whitelaw has rendered great service to the movement for obtaining uniformity of practice in the compilation of railway accounts, both before and after the passing of the Railway Companies (Accounts and Returns) Bill.

Railway Officers at the Ministry of Munitions.—Among the staff of the Ministry of Munitions are Mr. E. C. Geddes, deputy general manager, North Eastern Railway; Mr. H. Fowler, chief mechanical engineer, Midland Railway; Mr. W. D. Bain, head of the carriage and wagon department, Midland Railway; and Captain C. L. Conacher, late traffic manager, Cambrian Railways. The last-named has during the past nine months been serving as a railway transport officer at the War Office. **Mr. T. R. Johnson,** the late Chief Commissioner of Tramways and Railways in New South Wales, has been added to the department of the Ministry of Munitions which will consider the claims of the employers for the retention of workmen who have placed their names on the register of Volunteer Munition Workers. Mr. Johnson is also a member of an Advisory Council appointed by Mr. Lloyd George to assist him in settling any labour questions which may arise in matters affecting munitions.

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TRAMWAY AND LIGHT RAILWAY NOTES.

BIRMINGHAM.

TRAMWAYMEN'S LOYALTY.—QUINTON LIGHT RAILWAY SCHEME.

Adverting to his recent criticism of tramway and omnibus employees outside of the city for refusing to work with women conductors, Ald. Brooks, of Birmingham Watch Committee, on July 21, said that his remarks did not apply to tramwaymen employed by the Corporation. Women have started work on one of the Corporation tramway routes, and the Tramwaymen's Union have informed the manager that they are willing to render the women every possible assistance. The Corporation have applied to the Board of Trade for an extension of time for the completion of the light railways authorised by the 1912 Order and the Quinton Order for 1913. The Tramways Committee hope to complete the undertaking by September of 1918. Worcestershire County Council Highways Committee have conferred with representatives of Birmingham Tramways Committee and of Oldbury Council on the subject of the proposed light railway from King's Head to Quinton. It was not considered desirable to proceed with the scheme during the period of the war.

BRADFORD.

PROPOSAL FOR A TRAMWAYS CENTRE.—TRACK RENEWALS.

The Tramways Committee are putting before the committees concerned a project for establishing a central tramways loading station in Forster Square. While expressing approval of the principle of the scheme, the Parks Committee have asked to be furnished with full details. At an estimated cost of £15,000, the Tramways Committee have recommended track renewals on various tramways.

BRIGHTON.

EFFECT OF PAVING ON FARES.

In his tenth annual report on the Corporation Tramways, Mr. W. Marsh, the engineer and manager, states that it coincides with the first complete decade of the history of the undertaking since it reached its present size. Ten years ago the tramways had never really paid their way. They were still in the construction stage, and had to start what was really a new business. Notwithstanding the uphill and discouraging work involved, the results have been encouraging. Since 1908 the receipts have shown a steady growth. There has been a heavy increase in the cost of maintaining and renewing the permanent way, and the manager does not see much prospect of obtaining relief for years to come. As long as the public demand wood paving over so large a part of the system, they will have to pay higher fares. The future development of traffic is contingent upon the building of houses further into the country. The surplus for the past year would have reached £2,500 if it had not been for allowances to the dependants of employees who enlisted and capital charges on the Railless Traction Act.

DARWEN.

MANAGER TO REPAIR AND MAINTAIN THE TRACK.

The Darwen Town Council have approved the action of the Tramways Committee in placing the repairs and maintenance of the tramway track under the control of the general manager, Mr. F. J. S. Hosken.

DUNDEE.

PURCHASE OF A SUBURBAN LINE.—TWO AND A HALF MILES FOR A PENNY FARE.

The award of Mr. A. Carter, C.E., has been issued in the arbitration between Dundee Corporation and Dundee, Broughty Ferry and District Tramways Company regarding the price to be paid by the Council for about a mile of the line adjoining the old eastern boundary of the city. It is for £9,255. The company claimed £14,500, whereas the Council offered £8,500. Mr. Fisher, general manager, Dundee Corporation Tramways, has informed the committee that practically no extra fares would be obtained for conveying passengers from the centre of the city over the portion of the Broughty Ferry Company's track which had been obtained by arbitration. The penny fare at present extended a distance of 1⅛ miles; 1,520 yards was now to be added, making 2½ miles for a penny. Convener Johnston mentioned that the penny fare was agreed to on the understanding that the company fares to West Ferry, Broughty Ferry, and Barnhill were reduced by a halfpenny. The public would get the benefit.

GLASGOW.

WAR EXPENDITURE.—THE RECRUITING CAR.—EXTENSIONS DEFERRED.

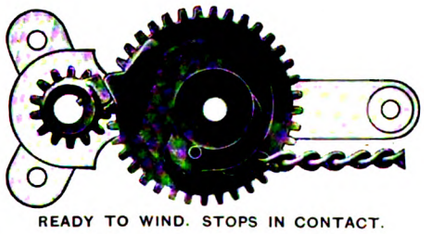
According to the twenty-first annual report of Glasgow Tramways Committee, a sum of £51,816 was expended in connection with the war, including £39,736 in allowances to dependents of employees who are serving with the forces, £6,231 in car tokens to military, etc. £5,006 bonus to employees, £541 for general recruiting, and £301 in equipping a pipe band for the 15th (Service) Battalion, H.L.I. For the year ended May 31 last the Tramways Committee placed £31,000 to the credit of the third party accident risk, consequent upon the decision of the Corporation to undertake the liability. The claims and other expenses during the year totalled £13,129. During the war only one route of the forty miles of single track authorised in

Note the STOPS which form the special feature of The "Peacock"

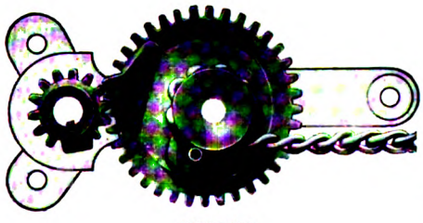
IMPROVED BRAKE

(Patent),

and by preventing the drum from over-running on release save three quarters of a revolution of the handle at each application.



READY TO WIND. STOPS IN CONTACT.



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"PEACOCK" BRAKES

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Have been supplied to the following tramways amongst others:—

MANCHESTER	698
BIRMINGHAM	458
SALFORD	428
METROPOLITAN	728
CROYDON	150
HASTINGS	130
WAKEFIELD	130
NOTTINGHAM	112
RHONDDA	108

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the Act of last year has been begun, namely, from Cathcart to Clarkston. When a third of the route had been completed, the work of street widening was entered upon at Netherlee. While the latter work is to be continued, the laying of the track is to be suspended in view of the need for economy during the war. The recruiting tramcar has been in use freely during the past few weeks, accompanied by the Tramways Department's Band.

HULL.

IMPORTANT REPORT BY THE DEPARTMENTS COMMITTEE.

After sitting for some months to consider the working of the various departments of the Hull Corporation, the Departments Inquiry (Special) Committee has reported as follows on the tramways department:—"The committee are of opinion that the present system of dual control of this department is not conducive to the best interests of the undertaking. The actual effect of the traffic and engineering sides being under separate management is that the individual who is responsible for the cost of upkeep, current consumption, and all engineering costs has no control over the speed at which the cars run, the loads they carry, or the men who drive them. (As the result of their visit to various depots the committee came to the conclusion that overloading the cars is leading to increased expenditure in repairs.) Probably it is one result of divided control that, although the cars are metered for current consumption, no system of rewards or penalties for economical or excessive consumption is in operation. The committee also noted that at the Liverpool Street depot there is a workshop employing men (joiners and painters) who are engaged on tramway work, but who are not under the control of any official of the Tramways Committee, but who are employed by another committee which is not responsible for tramway costs. The committee recommend that the Tramways Committee be requested to submit to the Council a scheme for the unification of control under a general manager, who shall be responsible for the whole undertaking, and shall have control over all men engaged in tramway work. In making this recommendation the committee desire it to be clearly understood that they have "no intention of suggesting that the present officials in charge of the tramways are not doing their best under existing circumstances."

LEEDS.

POWER PLANT.—NEW TRAMWAY OFFICES.—THROUGH RUNNING TO BRADFORD AND WAKEFIELD.—A RECRUITING CAR.

In his annual report, recently issued, Mr. J. B. Hamilton, general manager, Leeds Corporation Tramways, says that owing to the unsatisfactory running of two large generating units installed at the electricity department at Whitehall Road, coupled with the increased demand for current, it became necessary to start up the direct current plant at the tramway station at Crown Point again on November 4, and to consider the best means of ensuring a sufficient supply for both the electricity and the tramways departments. After extended inquiries, a 3,000-KW. turbine and alternator were ordered from the British Thomson-Houston Company, of Rugby, and it is hoped to have the new machinery in operation about the end of July. The office accommodation of the Leeds Corporation Tramways in Standard Buildings has for some time been inadequate. In February, 1914, the Council decided that the site owned by the department at the corner of Swinegate and Briggate should be used for the purpose, and it is anticipated that sufficient rooms will be ready about January 1 next, so that the general offices may be removed there. The number of through tickets to Bradford issued on Leeds tramway cars during the year ended March 31, 1915, was 297,535. To Wakefield 94,737 through tickets were issued. The Tramways Committee have placed a tramcar at the disposal of the Territorial battalions who are forming third line units. Accompanied by a band on top the car travels to a terminus, where a meeting is held, and men who come forward are examined and attested on the spot if found fit.

LEICESTER.

INCREASE OF FARES.

Leicester Corporation, on July 27, adopted a recommendation made by the Tramways and Electricity Committee in the following terms:—That the charge for early morning return tickets, transfer and overlapping tickets, and outer return tickets be 1½d. instead of 1d.; that the fare on Stoneygate, Aylestone, and Clarendon Park sections be increased to 1½d. for the full journey, with a penny stage; and that on and after September 30 next the charge to electric light consumers be increased by ½d. per unit, and the charge to power consumers by 20 per cent. Amendments were moved to the fare proposals, but were defeated by 38 votes to 17. Alderman S. Flint, chairman of the committee, in moving the recommendations, said that owing to the war the increased cost of working made it necessary to find another £19,000 of income for the tramways. It was estimated that the increases in fares would bring in £16,000, which would leave a deficit of about £3,000. In charging the 1½d. fares it was proposed to make a 1d. stage of practically two-thirds of the distance. In making their estimate they had not allowed anything for reserve fund nor for the relief of the rates. There was a more serious item than the advance in the price of materials. They would have to pay for their loans a higher rate of interest, so that it might cost next year £4,000 or £5,000 more than they estimated. It might be said they ought to make allowances for economies. If critics would show them where those economies could be effected the committee would be much indebted to them. There were now between 60 and 70 fewer men at work than originally. He was afraid they might lose more men, especially when the register was completed and came into operation. New men on the cars consumed considerably more current then the experienced motor driver, and that was where part of their expenses went. Alderman Bantam, the seconder, mentioned that the concessions to the soldiers were costing the undertaking £5,000 a year.

PERTH.

CHANGE IN THE TRACK MAINTENANCE AUTHORITY.

On the recommendation of the Tramways Committee, supported by the burgh surveyor, Perth Council have decided to allow the Tramways Department to undertake the future maintenance of the track, including the 18-in. margins.

SWANSEA.

AN EXTENSION SCHEME SANCTIONED.

The Light Railways Commissioners' Order authorising the construction of further light railways by the borough of Swansea has been confirmed by the Board of Trade. While the war is in progress the work will not be proceeded with.

WEST HAM.

DAMAGE TO TRAMWAYS BY HEAVY MOTORS.

Mr. J. S. D. Moffet, general manager of the West Ham Corporation Tramways, in his report for the past year, alludes to the destructive effect of heavy vehicular traffic on sett paving and concrete foundation of the track. High speed, vibration, and suction account for the extraordinary nature of the damage done to main roads by heavy motor vehicles. The high speed at which solid rubber-tired vehicles, such as motor lorries and motor-omnibuses are allowed to travel, far in excess of their legal limit of 12 miles per hour, as Mr. Moffet says, is undoubtedly the cause of most of the damage, as when travelling at speed these vehicles become practically "travelling pile-drivers" or "rapid-moving power hammers." In addition to the effect of speed and vibration, the damage done by the solid rubber tires of heavy vehicles can easily be traced on a muddy sett-paved road by noticing the manner in which the racking is sucked out of the joints. The wider the joint the quicker the action appears to be completed, and in places where most of the rack has disappeared the setts will be seen to be quite loose and to lie in the direction of the flow of traffic. This suction greatly expedites the breaking-up process and increases considerably the annual cost of maintenance.

PATENT LIST.

Specially abstracted for "The Tramway and Railway World" from the Official Journal of Patents.

*** If the inventions have been communicated the names of the communicators are given below in italics.

APPLICATIONS.

The following Applications for Letters Patent have been filed:

9,439 Car doors—W. M. Mosier.
9,481 Railway signalling apparatus—A. V. Shewry and V. A. Shewry.
9,543 Signalling apparatus—G. Brodsky.
9,549 Ventilation of vehicles—G. M. Trimingham.
9,628 Electric welding—British Thomson-Houston Company, Limited (*General Electric Company*).
9,655 Brakes for vehicle wheels—W. H. McMillen and W. Connolly.
9,685 Controlling devices for self-propelled vehicles—A. F. W. Shorland and C. Talbot, Limited.
9,716 Resilient wheels for vehicles—J. Davies and F. D. Davies.
9,737 Pneumatic tires—F. Merricks.
9,744 Locks for tramcar seat backs—R. P. S. Beattie.
9,752 Anti-rail-creep appliance—J. Parkinson.
9,811 Automatic danger signal train-stopper—D. Wigley.
9,815 Reversible car seats—S. Smith.
9,823 Apparatus for railway signalling—J. W. Bell.
9,915 Brake for electric vehicles—Right Hon. H. L. Samuel, W. Slingo, H. C. Gunton, and C. H. Douglas.
10,039 Method of securing rails to sleepers—D. Leyshon.
10,226 Inter-connecting the electrical conduits of two railway cars—J. Wollenmann.
10,269 Steam-driven vehicles—H. Viney.
10,366 Fishplate—A. J. Johnsen and H. E. Johnsen.
10,457 Method of preventing the skidding of road vehicles—S. B. D. Morgan.
10,530 Variable speed gearing—G. Pollard and Menco-Elma Syndicate, Limited.
10,547 Rail joints—J. P. Schoelerman.
10,549 Motor valve gear—E. Bugatti.
10,610 Single-chamber brakes—W. Hildebrand.

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10,625 Speed recording apparatus for locomotives—I. von Lechner.
10,661 Holders for tramway and omnibus tickets—G. A. Bishop.
10,745 Points for tramways and railways—Edgar Allen and Company, Limited, W. E. Robinson, and E. Larmuth.
10,751 Railway signalling—S. W. Harries.

SPECIFICATIONS PUBLISHED.

1913.

21,014 Metallic cross-sleeper for railroad tracks—Maas.
25,677 Railway car seats—Bennett.
26,614 Bodies of motor road vehicles—Van Raalte.

1914

6,182 Electric current collectors—Janssen.
6,520 Means for electrically operating railway signals—Siemens Brothers and Company and Ferreira.
6,588 Transmission gearing for power-driven vehicles—Sternberg.
14,006 Construction of electric contact conductors for railway tracks—Colas.
14,024 Railway signalling—O'Donnell and Glenn.
14,105 Construction of the bodies of motor cars—Wilkinson.
14,587 Motor vehicles—Duryea.
20,136 Sleepers for permanent way—Sandberg.
20,177 Speed indicators—Gresens and Faerber.
24,545 Tramway points and switches—Burton.
7,010 Differential gearing for motor vehicles—Romeiser.
14,036 Friction blocks for brakes—Soc. Francaise Mettallurgique (Procedes Griffin) and Soc. G. Getting et A. Jonas.
14,516 Apparatus for holding and distributing railway and tramway tickets—Mottershead.
14,588 Motor vehicles—Duryea.
14,964 Fishplates for railway rails—Sutcliffe (*Olson*).
7,214 Trolley wheels—McReynolds.
7,265 Regenerative braking of electric motors—Brown, Boveri et Cie.
7,818 Speed indicators—Ihle.
7,930 Ventilators especially for use in railway vehicles—Rosemeyer.
8,245 Railway signals—Roudolf.
14,586 Motor vehicles—Duryea.
14,984 Electric railway systems—Hobhouse, Slingo, etc.
21,364 Device for attaching railway chairs to sleepers—McMurdo.
3,907 Railway and tramway crossings—McKay.
15,553 Means for mechanically operating railway points from the vehicles—Errington.
15,724 Slack adjusters for brakes—Anger.
16,031 Ventilation of railway vehicles—Mead, McLean, and Company, and Mead.
16,245 Motor-driven road vehicles—Stanhope.
16,519 Starting apparatus for engines of motor-cars—Joyce.
19,608 Construction of motor road vehicles—Low.
24,540 Car trucks—Adams.

1915.

1,192 Automatic train stops—Rogers.
4,000 Motor car bodies—Ashton.
1,737 Vacuum brake apparatus for railway vehicles—Gresham.

Colonial and Foreign Tramways Traffic Returns.

NAME OF COMPANY.	1914. WEEKS ENDED. June 27.	July 4.	July 11.	July 18.	July 25.	1915. WEEKS ENDED. June 26.	July 3.	July 10.	July 17	July 24.	AGGREGATE. Wks.	1915.	Increase or Decrease.
	£	£	£	£	£	£	£	£	£	£		£	£
Anglo-Argentine	54.387	51.759	53.771	53,184	53,124	49,296	48,158	52,553	49,999	49,235	29	1,484,478	−133,340
Auckland	(28 days)	19,023	...	...	...	(26 days)	19,139	...	...	...	52	267,248	+ 914
Burma ... ... Rs.	4,863	5,848	5,500	4,843	4,570	4,224	4,037	4,770	4,476	4,900	...	...	− 46,626
Calcutta ... ... Rs.	64,444	68,450	70,336	69,918	70,516	67,277	66,648	70,582	68,476	67,430	29	19,23,503	− 91,087
Hong Kong ... ... $	11,286	11,757	11,197	10,556	13,221	12,416	11,217	10,429	12,445	12,891	30	323,164	− 27,869
Madras .. . ... Rs.	(14 days)	27,685	(14 days)	32,189	...	(14 days)	29,180	(14 days)	32,086	...	28	374,921	− 2,937

Companies Issuing Monthly Statements.

	1914. Feb.	March.	April.	May.	June.	July.	1915. Feb.	March.	April.	May.	June.	July.	Wks.	AGGREGATE. 1915.	+ or −.
	£	£	£	£	£	£	£	£	£	£	£	£		£	£
Brazilian Street Mlrs.	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
BrazilianTraction Mlrs	5785027	6153984	5,941,220	6,180,830	6,188,900	...	5797500	6294910	6,333,460	6,670,110	6,591,940	...	26	37,684,110	+ 1,239,922
Brisbane	25,260	28,325	28,610	29,860	28,590	...	26,590	30,740	29,890	31,780	29,880	...	26	178,500	+ 9,525
British Columbia $	704,003	717,251	698,508	678,314	660,383	...	558,512	557,135	540,861	512,568	498,093	...	52	7,306,563	− 1,482,724
Buenos Aires Pt. & C.	...	...	...	..	...	...	...	...	...	...	...	...	—	—	—
Buenos Ayres Lacroze	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Cape Town	13,342	13,922	13,408	...	...	...	13,924	15,829	14,512	...	...	...	17	59,925	+ 4,607
Carthagena& Herrerias	2,919	2,425	2,069	2,202	1,405	2,416	1,822	2,436	1,496	1,931	2,059	2,157	31	12,805	− 3,407
Cordoba	...	...	13,406	14,667	13,974	...	...	...	13,607	14,458	14,091	...	13	42,156	+ 109
East India	1,701	1,884	1,837	1,885	1,966	...	1,649	1,846	...	2,119	2,194	...	47	21,553	− 463
Kalgoorlie	2,169	2,476	2,820	3,025	...	...	2,352	2,638	2,841	3,269	...	...	21	13,472	+ 642
La Plata	4,766	5,178	4,716	4,727	4,560	...	4,016	4,582	4,269	4,489	3,876	...	26	25,772	− 3,472
Lima	33,779	34,665	34,153	33,215	33,499	...	30,173	34,180	31,615	31,700	31,650	...	26	192,360	− 14,821
Manila ... ... $	153,300	137,200	134,300	138,600	132,500	...	123,000	119,984	117,450	120,475	116,875	...	26	726,002	− 107,631
Melbourne	64,000	63,000	...	...	...	...	59,086	64,506	...	...	...	...	13	186,321	− 9,179
Mexico ... ... $	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Montevideo	35,805	32,630	29,650	29,016	28,049	...	30,007	29,716	26,786	27,771	24,266	...	34	226,692	− 30,554
Port Elizabeth ...	3,510	4,535	3,758	...	...	...	3,149	3,346	3,371	...	...	...	17	13,968	− 2,665
Puebla ... ... $	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Rangoon	5,009	6,475	5,367	5,323	4,997	4,975	4,991	5,217	4,964	4,887	4,997	4,629	31	34,374	− 2,935
Toronto ... ... $	777,683	836,328	830,299	871,733	861,938	...	767,326	820,750	795,816	795,262	787,558	...	26	4,810,063	− 215,863
Winnipeg ... $	350,977	347,812	337,414	337,664	335,012	...	314,658	303,209	284,856	263,302	255,549	...	26	1,752,256	− 339,296

(*Continued on page 138*)

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TRAFFIC RETURNS—*continued.*

Tramways and Omnibus Undertakings in the United Kingdom.

NAME OF COMPANY OR CORPORATION.	1914. WEEKS ENDED.					1915. WEEKS ENDED.					AGGREGATE.		
	June 27	July 4	July 11	July 18	July 25	June 26	July 3	July 10	July 17	July 24	Wks.	1915.	Increase or Decrease.
	£	£	£	£	£	£	£	£	£	£		£	£
Aberdeen Corporation ...	1,780	1,948	1,889	1,775	2,248	1,832	1,753	1,869	1,783	2,053	7	13,615	– 207
Accrington Corporation ...	672	617	620	621	627	559	548	569	559	552	16	8,997	– 932
Ayr Corporation	408	427	489	534	1,248	407	414	487	608	1,051	10	4,768	– 321
Bath Electric	*	...	...	...	...	...	...	...	...	...	—	—	—
Birkenhead Corporation ...	1,320	1,351	1,297	1,300	1,247	1,385	1,452	1,449	1,438	1,438	16½	22,768	+ 1,107
Birmingham Corporation ...	12,711	13,281	13,012	12,527	12,307	13,273	13,365	13,189	13,819	14,154	17	217,903	+ 5,411
Blackburn Corporation ...	1,381	1,367	1,401	1,389	1,414	1,352	1,319	1,193	1,251	1,420	17	22,265	– 1,194
Blackpool and Fleetwood ...	914	1,702	1,505	1,219	1,559	681	1,236	1,108	961	1,346	29	16,257	– 3,581
Blackpool Corporation ...	1,788	3,088	3,062	2,832	3,051	1,214	2,190	1,932	1,699	2,064	17	23,297	– 8,103
Bolton Corporation ...	2,917	2,669	2,853	2,859	2,817	2,739	2,955	2,785	2,867	2,901	17	44,893	– 3,456
Bournemouth Corporation ...	2,226	2,157	2,433	2,374	2,515	1,953	2,122	2,026	2,097	2,178	17	36,008	– 1,350
Bradford Corporation ...	6,149	6,623	6,427	6,713	7,077	6,381	6,596	6,474	6,676	6,642	17	109,578	+ 1,096
Brighton Corporation ...	1,435	1,384	1,261	1,277	1,265	1,121	1,201	1,148	1,186	1,250	16½	18,051	– 1,437
Bristol	9,547	10,489	9,925	10,394	9,450	9,802	10,371	10,102	10,344	9,823	29½	270,723	+ 20,985
Burnley Corporation ...	1,629	1,764	1,621	1,662	1,640	1,498	1,758	1,700	1,569	1,610	17	27,288	– 3,057
Burton-on-Trent Corporation	304	332	322	309	325	...	...	317	307	300	17	4,800	– 360
Bury Corporation	1,438	1,454	1,448	1,387	1,356	1,358	1,404	1,403	1,366	1,440	16½	23,217	– 607
Cardiff Corporation ...	2,953	2,994	3,042	3,103	2,830	2,701	2,727	2,821	2,801	2,828	16	44,749	– 3,867
Chatham and District ...	1,068	1,081	1,071	1,085	994	1,208	1,296	1,366	1,336	1,303	29	32,350	+ 5,690
Chesterfield Corporation ...	252	285	268	275	280	264	284	261	272	279	16	4,301	– 327
Colne Corporation... ...	287	317	363	301	323	234	300	270	267	324	—	—	—
Cork Electric	554	608	614	588	570	559	560	590	540	514	29	14,278	– 337
Croydon Corporation ...	1,891	1,990	1,832	1,847	1,793	1,987	1,898	2,069	1,894	1,866	16	30,761	+ 509
Darlington Corporation ...	270	281	274	280	288	257	276	281	276	285	16½	4,318	– 114
Derby Corporation ...	1,036	1,117	1,086	1,094	1,044	1,045	1,107	1,031	1,072	1,086	42	17,430	– 234
Dover Corporation ...	252	284	296	320	301	317	332	348	343	360	16	5,127	+ 865
Dublin and Lucan ...	312	...	224	186	186	317	...	190	164	165	3	520	– 78
Dublin United	6,657	7,722	6,476	6,792	6,595	6,766	6,834	6,421	6,310	6,530	29	175,987	+ 5,425
Dundee City	1,370	1,375	1,403	1,504	1,462	1,367	1,379	1,429	1,356	1,425	9½	13,113	– 163
East Ham Corporation ...	1,170	1,155	1,122	1,156	1,109	1,353	1,326	1,397	1,335	1,353	16½	21,993	+ 4,046
Exeter Corporation ...	371	408	386	397	386	387	389	409	403	414	16	6,293	—
Gearless Motor 'Buses ...	*	...	...	...	...	...	...	...	...	...	—	—	—
Glasgow Corporation ...	22,352	21,615	21,653	19,991	15,126	21,999	22,566	21,700	21,452	17,842	8	168,495	+ 6,517
Glossop (Urban Elec. Supply Co.)	124	135	132	135	126	129	134	125	134	138	30	3,597	– 140
Halifax Corporation ...	2,261	2,442	2,288	2,298	2,257	2,349	2,286	2,252	2,243	2,280	16	36,401	– 348
Hastings and District ...	1,079	1,228	1,160	1,345	1,263	1,010	1,024	1,028	1,059	1,063	29	25,188	– 1,847
Huddersfield Corporation ...	2,357	2,585	2,469	2,362	2,327	2,640	2,753	2,629	2,653	2,849	16	44,919	+ 4,490
Hull Corporation	4,223	3,409	3,228	3,214	3,173	2,920	3,048	2,902	3,044	3,115	16	50,425	– 3,473
Ilford U.D. Council ...	617	654	621	607	574	675	702	726	670	684	16	10,975	+ 1,897
Ilkeston Corporation ...	163	133	145	136	129	135	133	136	142	140	17	2,234	– 84
Ipswich Corporation ...	532	557	535	572	535	606	638	647	622	647	16	8,882	+ 653
Isle of Thanet	1,014	1,148	1,335	1,395	1,430	433	474	502	498	577	42	14,477	– 7,885
Kilmarnock Corporation ...	171	176	173	171	193	177	179	175	177	204	10	1,749	– 55
Lanarkshire	1,975	2,015	2,255	1,998	2,039	2,109	2,009	2,114	2,013	2,627	29	54,925	– 1,119
Lancashire United ...	1,703	1,793	1,704	1,709	1,738	1,830	2,041	2,020	1,777	1,849	29	49,043	+ 1,154
Leeds City	8,466	9,128	8,916	9,037	9,035	8,878	9,253	8,863	9,111	9,286	17	148,931	+ 5,158
Leicester Corporation ...	3,028	3,229	3,060	3,099	3,117	3,176	3,238	3,045	3,210	3,244	30	87,576	+ 1,388
Leith Corporation... ...	783	813	851	848	895	796	806	825	831	858	10	8,094	+ 59
Leyton U. D. Council ...	1,541	1,573	1,476	1,503	1,438	1,683	1,600	1,841	1,725	1,717	16	26,208	+ 2,779
Liverpool Corporation ...	13,409	14,249	13,922	13,800	13,710	13,776	14,393	14,071	14,156	14,164	29	385,424	– 1,966
Llandudno and Colwyn Bay	425	497	545	527	637	385	416	418	468	538	34	9,489	+ 472
London County Council ...	44,726	45,628	44,868	44,773	43,547	44,897	44,534	47,297	46,405	46,999	16	671,098	– 40,222
London General Omnibus...	*	...	...	...	...	...	...	...	...	...	—	—	—
London United	*	...	...	...	...	...	...	...	...	...	—	—	—
Lowestoft Corporation ...	218	246	226	311	358	182	188	203	200	208	42	7,173	– 1,199
Maidstone Corporation ...	216	253	235	232	251	205	235	244	224	224	16	3,570	– 132
Manchester Corporation ...	18,238	19,368	18,830	18,465	17,734	18,317	18,799	17,824	18,045	18,218	16	298,811	– 1,532
Metropolitan Electric Tramways ...	*	...	...	...	...	...	...	...	...	...	—	—	—
National Steam Car	*	...	...	...	...	...	...	...	...	...	—	—	—
Nelson Corporation ...	204	212	220	199	228	177	196	228	184	217	16½	3,234	– 411
Newcastle-on-Tyne Corporation ...	8,668	5,230	5,357	5,326	5,222	6,564	6,412	6,484	6,546	6,642	16	103,738	+ 13,210
Newport (Mon.) Corporation ...	837	886	888	1,009	994	843	875	901	883	857	17	13,948	– 540
New St. Helens and District ...	873	936	924	960	906	1,069	1,096	1,155	1,072	1,074	3	3,302	+ 506
Northampton Corporation... ...	594	646	606	622	618	779	825	784	817	804	16	12,569	+ 2,545
Nottingham Corporation	4,273	3,729	3,846	3,692	3,608	3,783	4,581	4,499	3,844	3,839	16	61,118	+ 1,920
Oldham Corporation	2,408	2,418	2,403	2,353	2,471	2,338	2,236	2,406	2,420	2,444	18	40,992	– 818
Portsmouth Corporation ...	*	...	...	...	...	...	...	...	...	...	—	—	—
Preston Corporation	874	907	912	919	936	943	977	1,000	967	976	16	15,380	– 19
Provincial...	2,370	2,381	2,442	2,443	2,433	2,461	2,447	2,424	2,411	2,457	16	87,926	+ 8,176
Reading Corporation	749	774	747	790	759	811	814	858	823	814	16	12,773	+ 781
Rhondda Tramways	1,215	1,268	1,253	1,279	1,260	1,218	1,196	1,204	1,177	1,203	29	33,858	– 2,097
Rochdale Corporation	1,587	1,730	1,751	1,664	1,641	1,677	1,772	1,683	1,763	1,808	16½	28,923	+ 1,012
Rotherham Corporation	1,058	1,043	1,055	1,054	1,080	1,126	1,158	1,171	1,165	1,187	17	19,185	+ 1,662
Salford Corporation	5,444	5,491	5,502	5,319	4,964	5,397	5,332	5,292	5,429	5,413	16½	88,614	– 369
Sheffield Corporation	7,941	8,153	7,975	8,030	7,794	8,680	8,655	9,015	9,151	9,098	17½	151,331	+ 12,135
Southampton Corporation... ...	1,473	1,551	1,387	1,524	1,550	1,478	1,473	1,624	1,566	1,554	16	23,615	+ 885
Southend-on-Sea Corporation ...	1,181	1,272	1,306	1,464	1,446	728	737	838	837	837	16	13,039	– 4,875
South Metropolitan Tramways ...	*	...	...	...	...	...	...	...	...	...	—	—	—
South Shields Corporation ...	1,038	869	867	883	858	884	834	793	823	833	16½	13,142	– 246
Sunderland Corporation	1,702	1,708	1,711	1,655	1,629	1,505	1,559	1,526	1,572	1,597	17½	24,688	– 1,113
Sunderland District	586	659	599	640	601	588	604	577	568	591	38	20,969	– 1,320
Swindon Corporation	180	192	196	153	166	208	196	211	206	204	16	3,206	+ 311
Torquay Tramways	644	742	724	849	770	540	512	571	551	558	29	14,565	– 1,438
Tramways (M.E.T.) Omnibus Co. ...	*	...	...	...	...	...	...	...	...	...	—	—	—
Tyneside Tramways and Tramroads	1,823	907	639	604	596	828	768	645	651	675	3	1,971	+ 132
Wallasey Corporation	1,323	1,520	1,443	1,440	1,454	1,282	1,392	1,352	1,420	1,463	16½	21,433	– 1,068
Walsall Corporation	615	665	648	628	631	765	781	762	797	807	30	20,885	+ 2,211
Walthamstow U.D. Council ...	889	948	855	890	820	1,011	950	1,086	984	1,006	17	15,668	+ 1,449
Warrington Corporation	435	456	441	446	482	448	469	453	458	470	16	7,299	+ 62
West Ham Corporation	3,018	2,984	2,909	2,981	2,858	3,183	3,080	3,324	3,239	3,175	16	50,813	+ 3,619
Wigan Corporation	1,437	1,459	1,437	1,519	1,439	1,521	1,546	1,601	1,566	1,637	16	25,003	+ 185
Wolverhampton Corporation ...	1,110	1,214	1,188	969	1,038	1,090	1,119	1,115	1,065	1,120	17	18,832	– 225
Yorkshire (West Riding)	1,443	1,456	1,465	1,494	1,518	1,567	1,542	1,680	1,567	1,635	30	46,426	+ 2,699

* TRAFFIC RETURNS SUSPENDED.

Owing to the European war, the Government have taken over the railways of Great Britain as from August 4, and the issue of traffic returns has been suspended. Consequently the traffic returns of the electric railways which usually appear on this page cannot be given.

The Publication of the Traffic Returns of the Tramways marked with an asterisk in the above table have also been suspended during the war.

TRAMWAY DIRECTORIES.

A useful feature of this issue is the directory of electric railways and electric tramways which will be found among the advertising pages. This directory contains the names of the chief officals and the principal particulars relating to each undertaking.

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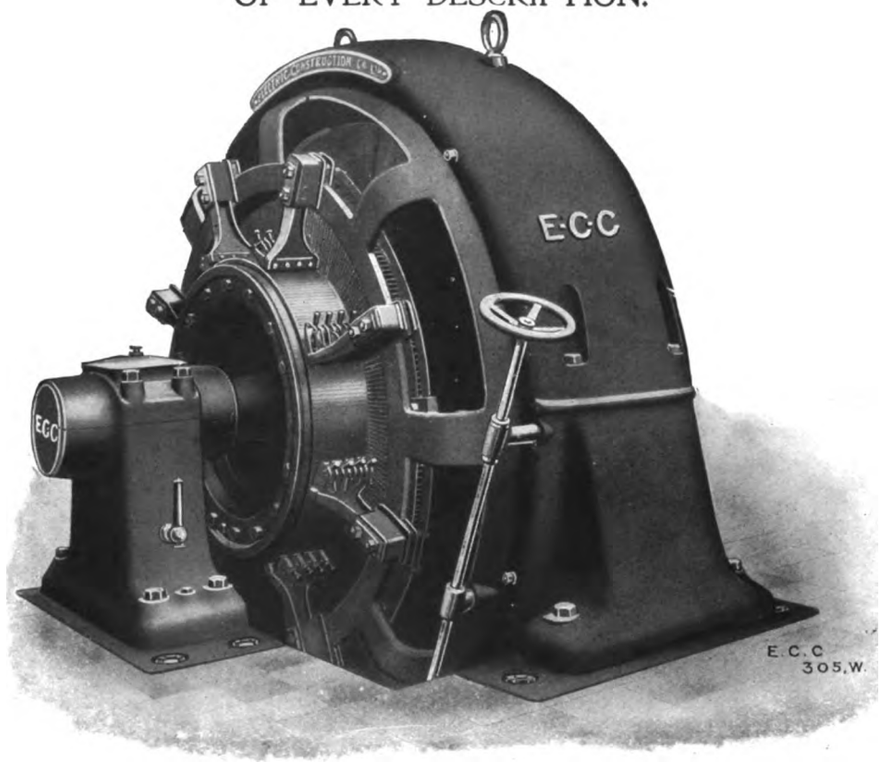

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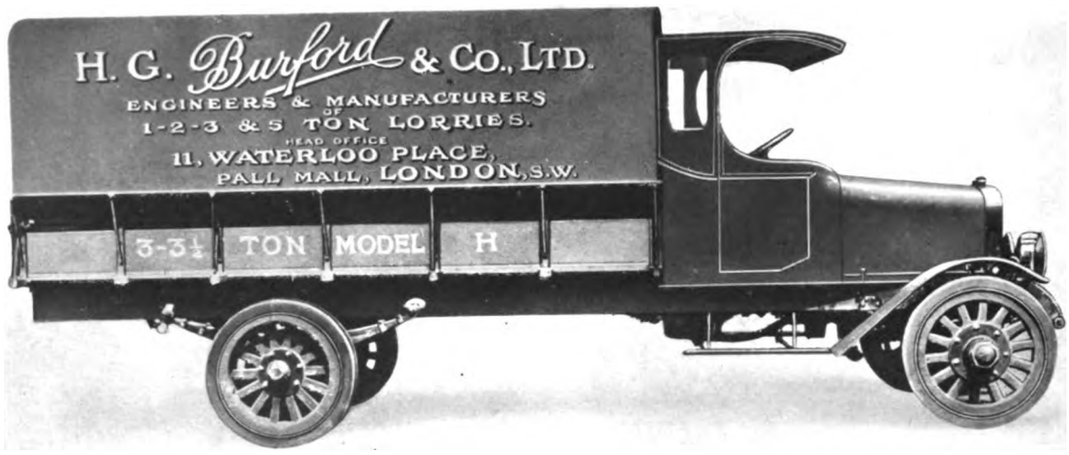

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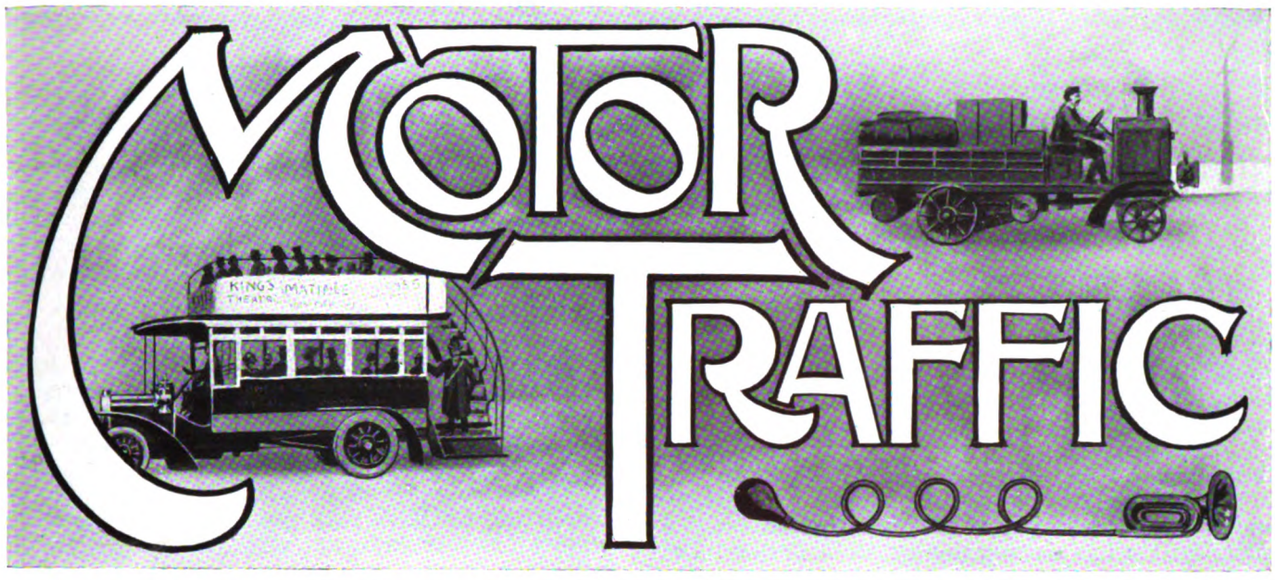

It is excusable at this crisis that a public body should spend time in debating whether they would be acting wisely in purchasing motor vehicles. Yet we can conceive of very few circumstances likely to render such an outlay inadvisable; for when the order is for one or two vehicles only it should be possible for such authorities to arrange for paying for them out of revenue. Public passenger and commercial vehicles are more imperatively needed now than before the war. They are a means of economising time and labour, to say nothing of enabling work to be performed that would otherwise have to be neglected owing to the widespread scarcity of horses. It may seem impossible at the moment to acquire a British built machine, which is the course dictated both by patriotism and by the nation's needs, but there should be no hesitancy in placing orders now, to be executed whenever the demands of the Government slacken sufficiently to allow of outside work being undertaken. The British manufacturer is open to accept such orders, and it is not impossible to find a firm who can give delivery in the near future. That, at any rate, is the experience of Rotherham Tramways Committee, who have induced the Town Council to sanction the purchase of three omnibuses. So self-evident is the economical nature of the expenditure that it is surprising to find the Council devoting lengthy discussion to the matter. In order to provide means of communication between Rotherham, as the market town, and numerous growing colliery villages outside the borough boundaries, the Corporation this year obtained powers to extend their omnibus services to several localities. For a considerable time demands had been made for the extensions, which will have the additional merit of conveying hundreds of miners to their work. This is essentially war labour, of local as well as national importance, for the district possesses munition factories, which require electric power and light.

* * * * * *

On the surface it may appear to be more difficult to put forward reasons to support the purchase of a motor wagon, but the balance of advantage is on the side of the Corporation or trader who expends the money for that purpose. Moreover, the benefit will become more marked the longer the war lasts, for draught horses are decreasing with every week occupied by the conflict. Already there are a number of municipal authorities who have purchased steam, petrol, or electric battery vehicles on account of the high prices demanded for horses. Rotherham Tramways Committee resolved not to expend £520 for a motor lorry, but probably if they will look beyond the needs of their own department they may yet decide to acquire the vehicle. The true economy would be to view the purchase in the light of the needs of the surveyor's department as well as of the tramways. Upon this matter some enlightenment may be gained from remarks made by Mr. J. B. Hamilton, commercial manager to Leeds Corporation, at the annual conference of cleansing superintendents. To a discussion upon papers dealing with the merits of various types of vehicles for dust collection and street cleansing, Mr. Hamilton was a contributor. His additional duties at Leeds, combined with the manner in which, as a consultant in traction matters, he investigates every new departure, have convinced him that the war means the extinction of the horse in the heavy transport requirements of local authorities. He looks forward to such improvements in mechanical traction as will enable it to overcome the expense of too rapid obsolescence. On the present indications he seems to pin his faith in the battery vehicle as the ideal one for municipal work in the future, and he gives a suggestion for its use that has not been made in any previous discussion. There are numerous towns which, though not possessing a municipal electricity undertaking, yet have a dust destructor, and Mr. Hamilton suggests that steam could be generated for electricity purposes, the charging of batteries included, thus reducing the cost of working electric vehicles. It is evident, however, that separate spheres of usefulness will be open to the battery and internal combustion vehicles, just as has been the case with the latter and tramways. Combined with the situation created by the war, the progress of the motor omnibus has led to the abandonment of the order under which powers were obtained for the construction of tramways between Brierley Hill and Rowley Regis. For most convincing evidence of the utility of the omnibus we have only to look to the undertaking which the British Electric Traction Company have built up in that department. At several tramways companies' meetings this year testimony has been borne to the part which motor omnibuses have taken in increasing the profits, and directors have announced their intention of adding to the facilities as soon as national affairs become normal.

The question of additional taxation to help towards the cost of the war threatens to become an acute one

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MOTOR TRAFFIC.

so far as the motor car and vehicle industry is concerned. There has been much specious talk about putting heavy taxes on what are called war profits, that is to say, profits of manufacturers in excess of the average of the last few years before war broke out. In some industries it will be very difficult to carry out any scheme of that kind without inflicting grave injustice and injury on manufacturers. In no direction is that more true than in the case of the petrol motor vehicle industry. So far as civilian work is concerned, the factories are paralysed. Everything has to give way to Government orders, and, contrary to popular opinion, these do not always pay well. Additional plant has to be purchased to meet the Government requirements, and much expense is involved. Then the American manufacturer has his opportunity, and he can sell both pleasure cars and commercial vehicles in this country without any import duty by way of restraint. So he cuts into the hitherto existing connections of the British manufacturer. When the war ends the Government work of the British maker will suddenly cease. He will have to spend more money in re-adapting his works for civilian orders, he will have to try to win back his connections in the face of a fully established American competition, and he will also have to fight against the fact that the market will probably be flooded with second-hand motor vehicles. Where then will be the "profits" which he is supposed to have made during the war time? The lot of the British manufacturer does not promise to be a happy one. It will no doubt be the duty of his associations to bring all the facts before the Government so that threatening disaster may be avoided. Not only should no unfair taxation be imposed, but an import duty should be placed on all foreign made motor vehicles. Some of the most determined exponents of the doctrine of free trade are already realising that for some time at least the rigidity of that doctrine must be relaxed, both for the purpose of raising additional revenue and of protecting the home manufacturer in circumstances of unprecedented difficulty. From the point of view also of protecting the national credit, it is necessary to discourage imports of luxuries and also of those necessities which can be produced in this country.

The need for motor transport drivers for the purposes of the war continues to expand with the expansion of the British Army. As a large proportion of the available drivers of long road experience have already been taken up, it seems likely that it will be found necessary to relax the present rule under which a man to be eligible as a military motor transport driver must have had three years' road experience. There does not seem to be any good reason for requiring such a long term as three years; what a man cannot learn in the course of, say, one year's practice in driving he is not likely to learn by any number of years at the job. It has also to be considered that before a man is accepted he has to undergo tests quite stringent enough to weed out unsuitables, no matter what the length of their experience. There is a good precedent for relaxing the present rule, because for a time it was not in force. We have heard of cases during that period in which men were accepted after only a few days' practice in the art of driving. That was going to the other extreme, and it would only be justified by necessity. But a very moderate amount of road experience compared to that of three years ought to be quite sufficient for learning the art of driving. The number of men available must be largely increased by a reasonable concession, and as we have said the service has always the protection of a thorough test before accepting any candidate.

Renewed attention has recently been drawn to the subject of the production of motor spirit by the cracking of heavier oils. During the past two years, the Standard Oil Company have adopted a cracking process which they are now working on quite a large scale in America. This process, which is based on a method patented in Great Britain by Dewar and Redwood as long ago as 1890, does not produce high-grade motor fuel. The product is, however, good enough for use in the agricultural tractors which are employed in such enormous numbers in America, and when mixed with some ordinary petrol it is fairly satisfactory in motor cars. So far as we are concerned, the effect of its production has been to free a certain amount of petrol for export to this country. In 1913, our petrol consumption in Great Britain was just over 100,000,000 gallons. In 1914, the anticipated import was 120,000,000 gallons, and this figure was not greatly disturbed by the abnormal circumstances. In 1913, only about 24,000,000 gallons of our fuel came from America, while last year the import from that country rose to about 40,000,000 gallons. It is stated that America herself uses something like 1,800,000,000 gallons of motor fuel annually. Consequently any new process that increases her surplus stock available for export is of great importance to us. A plant for manufacturing motor spirit by cracking in accordance with the Hall process has been erected near Thameshaven, England. This process is a new one and is regarded by some of our ablest authorities as a great advance on anything that has gone before it. It is stated that the oil produced by this method is not open to the objection urged against most cracked spirit to the effect that the spirit contains a residue of varnish, which rapidly gums up the valve of an engine. A good cracked spirit should not give a disagreeable exhaust. As regards consumption, it is approximately equal to benzole, which means that it is perhaps 15 or 20 per cent. better than petrol. Its use does not necessitate any adjustments in a carburetter set for petrol, unless the original setting provided for rather a rich mixture. In that case, the cracked spirit may show a smoky exhaust and cause sooty plugs, and the obvious remedy is to admit a little more air. Cracked spirit shares with benzole one very marked advantage over petrol. Its combustion is apparently slower, and the consequence is that it is not to the same degree liable to pre-ignition when the spark is advanced. This advantage means less gear changing and less racing of the engine. Some authorities believe that the great future of cracked spirit is in connection with the production of water gas for illuminating purposes. In works for the manufacture of water gas, the gas-oil used is cracked at a high temperature, and a portion at least of it might well be condensed into motor spirit by a slight modification of the process. Mr. Hall reckons that the works cost of producing a motor spirit in gas-works in this country would be in the neighbourhood of 5d. per gallon, whereas in independent works not concerned with the simultaneous production of water gas, he puts

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the cost at about 4½d. more. This latter, however, includes transportation and estimated selling costs, and the net saving by dealing with the spirit at the gas-works should, according to him, be about 2d. per gallon.

The lawsuit on the subject of commission paid on motor cars sold to the War Office ought to lead to the appointment of a Royal Commission to inquire not into that department of the national service, but into the question whether the political system of conducting the business of an Empire ought not to be discarded. If politicians cannot ensure that the War Department is adequately organised to cope with matters that require to be attended to with promptitude in the early phase of an international crisis, it is time that they gave place to men with more sense than can be credited to the average politician. One cannot read the report of the recent litigation without coming to the undeniable conclusion that, notwithstanding the prolonged inquiry held into War Office administration during the Boer War, the events of the last week in July, 1914, found the occupants of the building in Whitehall acting without any conception of the wisest course to be followed. No doubt the department concerned congratulated itself at having secured so promptly a large number of four-seated cars, but its action showed an entire lack of the elementary knowledge of the requirements of the situation, as well as of the powers vested in the War department. We refer to the right of the Government to obtain by impressment from makers and private owners any number of vehicles. This power was widely known among civilians, for it has again and again been mentioned in the discussions that attended the work of the Mechanical Transport Committee in forwarding the War Office subsidy scheme to promote the acquirement by business firms of suitable commercial vehicles to be at the disposal of the Government in time of emergency. It is not clear whether the official who made the purchase of private cars was identified in any way with the Mechanical Transport Committee. If he was his action is the more inexcusable, for a moment's thought would have told him that there is such a body as the Society of Motor Manufacturers and Traders, to say nothing of the two organisations that govern the affairs of private car owners. That these societies could have speedily arranged a scheme of purchasing any number of cars is shown by the promptitude with which one of them subsequently offered to place thousands of its members' cars at the service of the War Office free of charge. It would have been an easy matter to have obtained on reasonable terms all the cars that were necessary at the outset if tenders had been called for, leaving the bulk to be obtained by impressment, as was so speedily done in the case of omnibuses and commercial vehicles all over the country.

During the last few years the London Traffic Branch of the Board of Trade has annually issued a comprehensive report, including a census of traffic, by the aid of which the progress of the motor can be gauged. A much longer, though less exhaustive, record is, however, available in the series of enumerations which have been taken by Mr. Hewitt Griffin on behalf of *Motor Traction* during the past ten years, and it may be interesting in the light of the figures now obtainable to trace the advance that mechanical transport has achieved during that period. In Fleet Street, which is typical of central traffic, the motor omnibus for the first time exceeded the horsed omnibus numerically in 1908. In Edgware Road, which is typical of traffic between the city and residential London suburban areas, the motor surpassed its rival in 1907. A Sunday census at Putney Bridge, which serves to show the change in pleasure traffic, confirms the general impression that by 1910 the horsed omnibus was practically obsolete.

* * * * * *

With motor cabs the pleasure routes were naturally the first to show substantial progress, but everywhere the horsed cab has decreased rapidly since about 1908. It has not, of course, been so completely extinguished as the horsed omnibus, since cab traffic is more closely allied with private enterprise, and there still remains a conservative element of elderly or unprogressive drivers, who are, however, in a very small minority. It was really the taximeter that established the motor cab. Had horsed cab proprietors adopted these instruments the inroads of the motor would have been greatly checked. In Paris, which is essentially a city of light and fast motor traffic, the horsed cab is still far more in evidence than it is in London, though the horsed omnibus has been even more completely relegated to the scrap heap at the moment. Paris, after having been denuded by the war of all its motor omnibuses—some 1,100 in number—is in the course of re-establishing the more important services with a reduced frequency of new vehicles, similar to the old single-deck type, but of rather lighter construction.

* * * * * *

Enumerations respecting trade vehicles taken in London show a very much more gradual growth. While in the sphere of public service vehicles the horse has almost disappeared, in the class of trade vehicles the great traffic revolution is still in an early stage. The Edgware Road figures are perhaps the most typical. These, so far as the motor is concerned, rise from 1 per cent. in 1906 to 14 per cent. in 1914. The rate of change is on the increase, and it is clear that the period of doubt in the minds of traders terminated some three or four years ago, and the period of definite action which then started is progressing satisfactorily and without any check except for the somewhat disturbing conditions due to the war. Even these are not having so much effect as might have been expected. In Fleet Street the density of traffic and consequent obstruction by slow moving horsed vehicles is antagonistic to development. However, the motor percentage is about ten. In this connection it must also be remembered that there is a comparatively free parallel thoroughfare available along the Thames Embankment. On the whole, in the sphere of the public service vehicles, little remains but to maintain and replenish existing fleets and increase them slowly with due regard to the population and the travelling habit. In the sphere of trade vehicles, the bulk of the change has yet to come, and there are enormous prospects both for manufacturers capable of producing sound vehicles, and for users who do not wish to be left behind by their competitors.

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MAINTENANCE OF A THREE-TON VEHICLE.

NOTES BASED ON THE DENNIS SUBSIDY MODEL INSTRUCTION BOOK.

In considering the attention periodically needed by an industrial motor vehicle, reference must be made first and foremost to the necessity for regular lubrication, not only of all those parts where, through the presence of fillers or oil caps, the need of lubrication is advertised, but on all exposed threads which might conceivably get rusted up and make a comprehensive overhaul of the chassis much more difficult than it need be. Beneath the engine of the Dennis vehicle, a very capacious oil sump is provided. This contains about 5 gallons, so that the oil only requires to be replenished after 5,000 miles. It is a good plan to drain off a gallon of the used oil every week, and to replace with an equal quantity of fresh oil. At the base of the sump is a gear-driven pump, which forces the oil to the hollow exhaust cam shaft, and thence to the main bearings, timing gear, and inlet cam. From these points, the oil drains back to the false bottom of the crank case. Here it collects until it reaches a level at which scoops on the big ends dip into it and throw it up to the pistons and small end bearings. When the proper level in the false bottom of the crank case is exceeded, the oil overflows to the back of the sump through strainers. A driver ought to make a habit of assuring himself that the oil circulating system is in going order by turning his eye frequently on to the oil pressure gauge, which is visible through the dash.

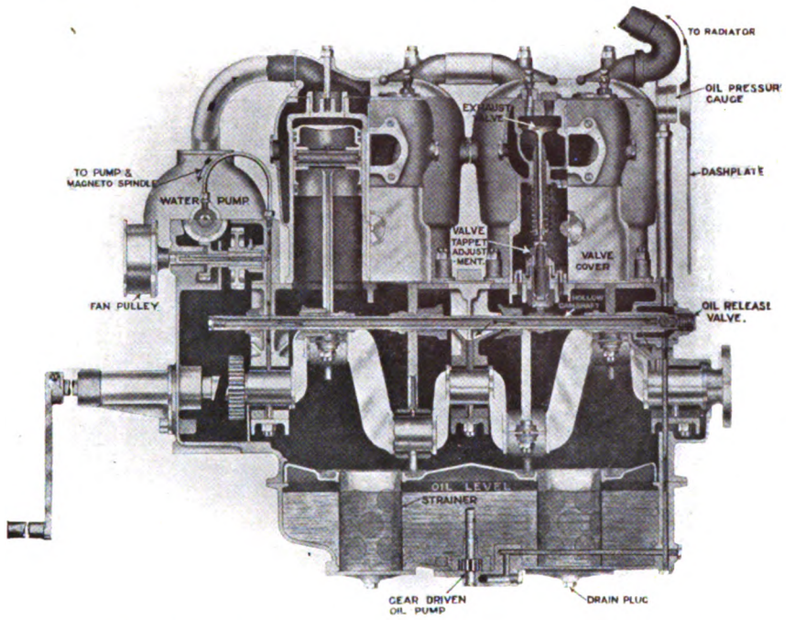

Fig. 1.—Lubricating System of Dennis Subvention Model Engine.

With the exception of the renewal of oil supplies, the most frequent attention likely to be required by the engine is the grinding in of valves about every 8,000 to 10,000 miles. Valve covers should be occasionally removed to see that springs and tappets are in order. This should be done when the engine is warm, so that, if need be the right adjustments can be made to ensure the proper clearance.

Unsatisfactory running of the engine may be due to faulty carburetter adjustment, or possibly to a loss of compression. The compression can be checked by opening three compression cocks and testing the compression of the remaining cylinder singly. Loss of compression may be due to a valve not seating properly. In that case, the valve seat will not be clean and smooth as it ought to be. Another possibility is a leakage through a valve cap or sparking plug joint. If there is any such leakage, the air can generally be heard escaping, if the engine is cranked round. The driver should never interfere with the setting of the engine governor.

Clutch stops are provided to bring the clutch to rest fairly rapidly, in order to allow the gears to mesh quietly. The stops should be kept adjusted up to their work. The whole clutch mechanism should be kept clean and well lubricated, the latter advice applying particularly to the internal spigot, which is lubricated through the plug marked A in Fig. 2. The failure of the clutch to slow down rapidly when withdrawn may be due to this spigot being dry, and not to any fault of the clutch stops. If the clutch gets fierce, a little oil should be applied to it at once. If it slips, it should be washed out with paraffin, and if this does not put matters right, the adjustment of the foot pedal should be checked, and if necessary corrected by means of the link B. Sooner or later adjustment at this point will be needed, owing to the wear of the composition face of the clutch. To ensure that the clutch is able to engage properly, it is a good plan to see that there is always a little play in the connections. In other words, when the clutch is engaged, it should be possible to pull the pedal up about a quarter of an inch above its natural position of rest. If the pressure of the clutch springs has to be increased, the nuts on the spring studs must all be turned an equal amount.

The Dennis gear box provides four speeds and reverse with direct drive on the top gear. When changing up, the engine should be run moderately fast, the clutch slightly disengaged, and the change speed lever moved to neutral. Then, after a slight pause, the lever should be brought into the position giving the higher gear. Between the third and fourth gears any intentional pause is unnecessary, owing to the extra time taken in causing the lever to traverse the gate. When changing down, the method of double clutching should be adopted. With a little practice this is quite easy, though it may sound complicated when put down in writing. The throttle lever should be left in its middle position, the clutch pedal slightly depressed, and the gear lever moved to the neutral position. The clutch should then be re-engaged for a second, after which the clutch pedal is again depressed, the gear lever being slipped into the lower gear with the last clutch movement. This process speeds up the male portion of the clutch, so that the relative speeds are calculated to cause engagement of the gear wheels without clashing.

The propeller shaft and spherical torque and thrust tube joint are well shown in Fig. 3. The only attention that the joint requires is regular and efficient lubrication. The oil should be maintained at the level of the filling pocket, which is situated midway along the chassis on the driver's side.

The rear axle naturally embodies the well-known Dennis system of worm gear. In lubricating the worm gear and differential, great care should be taken to see that no dirt or grit gets in with the oil and grease. When re-assembling after the chassis has been dismantled for overhaul, attention must be paid to correct alignment of the parts, and no end play should be allowed in any of the thrust bearings. Fig. 4 will help to show how the live axles can be withdrawn without jacking up the chassis, and also how, on their

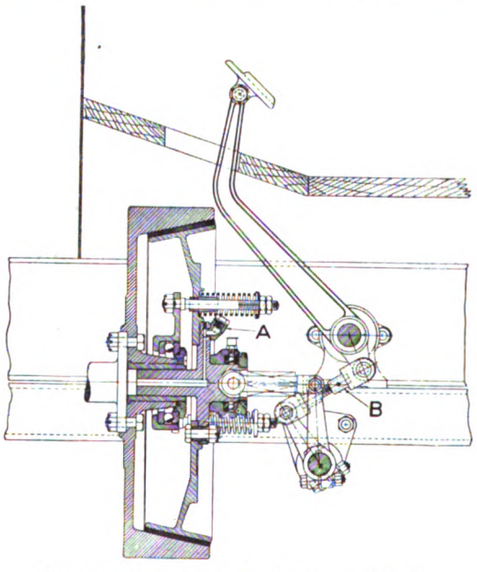

Fig. 2.—Cone Clutch of Dennis Model.

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withdrawal, the worm and worm wheel with the differential gear can be lifted out as one unit. Fig. 4 also gives an indication of the rear brakes. The transmission brake is shown in Fig. 5. It is of the slipper type, and must be kept in proper adjustment and well lubricated. The hand adjusting nut is shown in the diagram. The exposed thread on which it works should be kept oiled to prevent rusting. The diagram also shows the set screws for adjusting the slippers to clear the drum when the brake is off.

Part of the front axle and steering gear is shown in Fig. 6. The front wheel hub runs on a floating bush and a plain stub axle bearing,

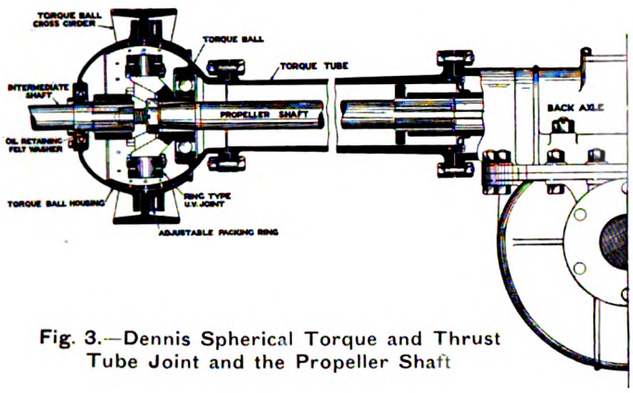

Fig. 3.—Dennis Spherical Torque and Thrust Tube Joint and the Propeller Shaft

and strict attention must be paid to lubrication. The ball thrust bearing of the steering swivel and all the ball steering joints must also be kept well supplied with lubricant. Similar attention is needed by the steering gear, which is of the worm and segment type. A small grease labricator is placed at the head of the steering pillar, and the steering gear box must be supplied with grease through the plug hole provided for the purpose. While attending to these and other points where lubricators are fitted, a careful inspection should be made of all nuts, connections, and split pins.

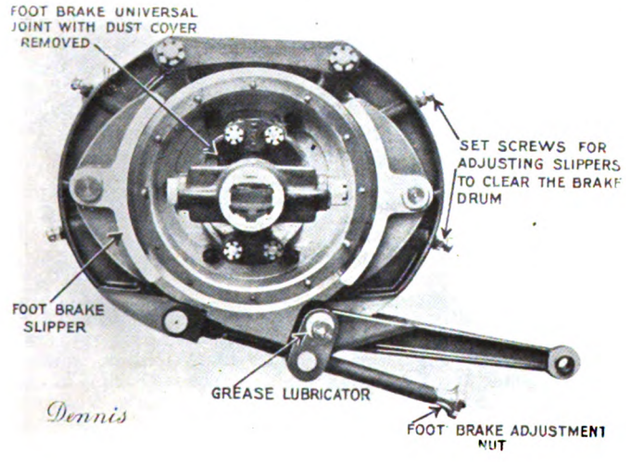

Fig. 5.—Transmission Brake of Dennis Subvention Model.

Space does not permit of going into details as to the methods of remedying the various little carburetter and ignition troubles to which all motor vehicles are liable. Such notes as are here given are, we hope, calculated to assist drivers of vehicles of any make, but the owners of Dennis vehicles of subsidy model, and also the men in charge of any of these, should apply to Messrs. Dennis Brothers, Limited, Guildford, for the very complete and admirable instruction book from which the information in this article has been obtained.

"The Coventry" Chain Company, Limited, Spon End, Coventry, have received a cable from their representatives in the United States stating that the company has been awarded a gold medal for their exhibit at the Panama Pacific International Exposition at San Francisco.

MOTOR VEHICLES FOR MUNICIPALITIES.

Gravesend Council have obtained a Ford motor ambulance at £212.

Croydon Guardians have placed an order for a two-ton Tilling-Stevens chassis.

Salford Council have purchased a Ford van for the use of the sanitary department.

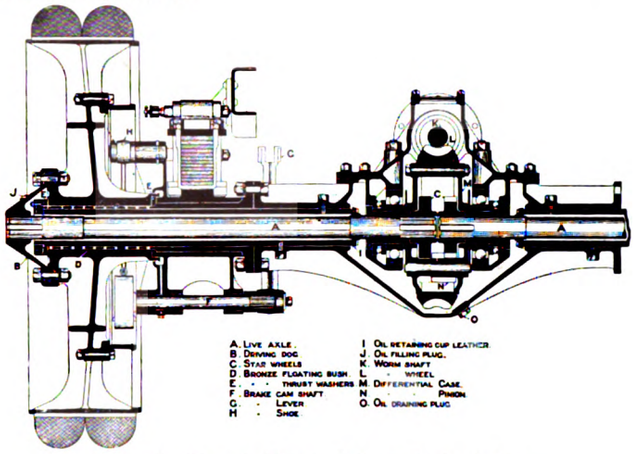

Fig. 4.—Dennis Worm-Driven Back Axle.

Stourbridge Fire Brigade have obtained sufficient funds by public subscription to enable them to purchase a motor fire engine.

York Council have voted £25 per annum to the tuberculosis medical officer to meet the expense of using his car for public duty.

Aberdeen Corporation have been recommended by the cleansing superintendent to purchase a Laffley street sweeper. The matter is under consideration.

Kensington Council were advised by the Works Committee to substitute a Ford motor car for the two cobs and a trap used by the borough engineer. The proposal has been referred back.

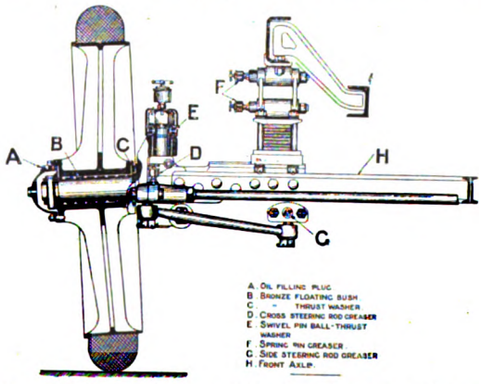

Fig. 6.—Front Axle and Part of Steering Gear.

Leeds Council, in lieu of purchasing a motor car for the gas works manager, have been recommended by the Gas Committee to make him an allowance of £35 per quarter in respect of the use of his private car for official work.

Kensington Council having been unable to obtain a motor wagon ordered from a London firm, are considering the question of purchasing a 3-ton coke-fuel motor chassis which the National Steam Car Company are prepared to supply in eight weeks if not prevented by Government work.

Southport Council have purchased a motor watering and haulage van from Messrs. Green and Son, Limited, Leeds, at £820, as the result of a month's free trial. It is estimated that by using a 5-ton motor for haulage there will be a saving of £300 per annum, after providing £139 for sinking fund and interest. It is proposed to pay the purchase money out of revenue. Mr. A. J. Jackson, the borough engineer, in his report on the trial, mentioned that the Barford motor road roller purchased five years ago, and the Laffly motor sweeper which was obtained six months ago, were giving satisfaction. The sweeper was saving £6 a week.

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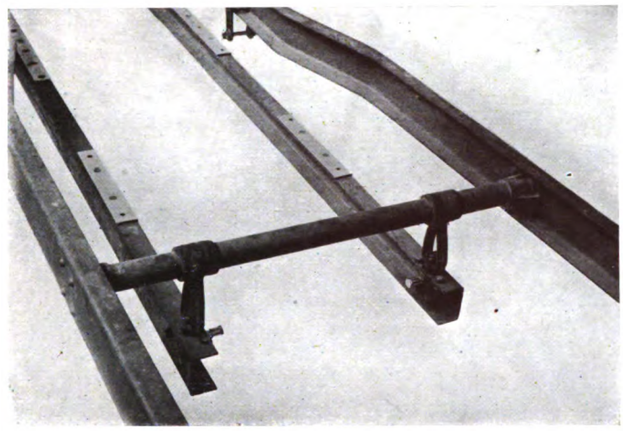
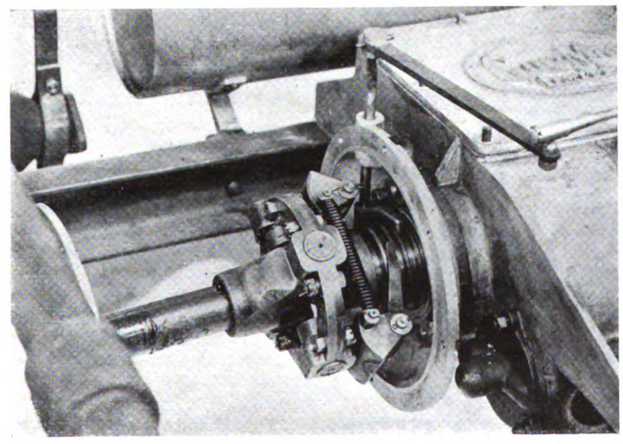
THE GUY INDUSTRIAL MOTOR.

A very interesting new industrial motor chassis has made its appearance on the British market. It is manufactured by Guy Motors, Limited, of Fallings Park, Wolverhampton, and is designed for a load of 25-30 cwt. It contains a number of excellent and original features, of which two are particularly worthy of comment. One of these is the genuine three-point suspension of the engine and gear-box. These are mounted rigidly on an underframe shaped like the letter U, with the curved end forward. At the centre of the curve is a ball and socket joint, attaching the underframe to a cross



Showing Three-Point Suspension.

member. At the back are two ball joints connecting the legs of the U to hangers, which are free to swing round a stout tubular cross member. This arrangement constitutes a genuine three-point suspension as distinct from designs in which the underframe is merely attached rigidly at three points to the main frame or cross members, and no free play provided except that which results from wear and the accidents of imperfect fitting. The Guy method certainly recommends itself to those who want a chassis for use under bad road conditions, where serious inequalities of surface are liable to cause severe strains to a rigid structure. The whole idea



Maximum Speed Governor of Guy Motor.

of three-point suspension really lies in the ability of the suspended part to swing round any one of the three points. In the example under notice this ability is actually realised.

The second very exceptional point is the location of the governor, which is at the end of the gear box. This gear box, by the way, provides four forward speeds, of which the third is the direct drive. The effect of putting the governor in the position chosen is, of course, that its action depends not upon engine speed, but purely upon road speed. In other words, the device is not applied with any intention of preventing the driver from running his engine at an unduly high rate of revolution, but aims entirely at preventing him from taking his car along faster than is good for the mechanism as a whole. The more usual method is sound from the point of view of the engine considered separately. If, however, the governor is so set as to prevent excessive road speeds when travelling on the top gear, it almost necessarily follows that it has an undue throttling tendency on low gears, reducing the hill-climbing capacity of the vehicle on any particular gear, and generally slowing down the average speed for this reason. In the Guy system the idea is to prevent a driver from running his car too fast, particularly when it is unloaded, and when for that reason the springs are operating under the worst possible conditions for protecting the mechanism from shock. When hill-climbing on low gears, the governor does not interfere at all. It merely comes into play when a road speed of twenty miles per hour is reached. The system is of great interest, and has very considerable possibilities. The idea of the indirect fourth speed is, of course, to lower petrol consumption when running light, the direct third speed being the normal state of affairs when the car is running loaded.

DIESEL ENGINE DEVELOPMENT.

POSSIBILITY OF ITS APPLICATION TO ROAD VEHICLES.

Although, numerically, the motor exhibits at this year's Exhibition of the Royal Agricultural Society suffered by the fact that many firms are more than fully engaged on Government work, the show was noteworthy for producing at least one new implement of great originality and of such promise that it may in the future prove to be the forerunner of an immense development. This was an oil traction engine fitted with an engine working upon the Diesel principle; that is to say, the oil vapour or spray and the air are separately admitted to the cylinder heads, the compression prior to ignition being in the neighbourhood of 200 lb. per sq. in., which is of course much in excess of anything that can be attained when the mixture is admitted in explosive proportions and subsequently compressed. The Diesel or semi-Diesel principle makes possible the use of a very high compression without fear of pre-ignition, and also enables the oil engine to approximate more nearly to the steam engine in the matter of the maintenance of steady pressure throughout the power stroke.

In the particular example under consideration, a two-cycle two-cylinder engine is used, giving the steadiness of a four-cylinder engine with the additional advantage of gradual combustion. There might be a risk of overheating, but this matter is attended to by a small air-cooled pump which scavenges the cylinders. Also, a water spray is injected at the same time as the fuel. For starting and other purposes, a supply of compressed air is stored, while the engine is working, by means of a pump. With the engine at rest, this pump can be applied to work after the manner of a single-acting steam engine, drawing from the stock of compressed air. It will, of course, run in either direction according to the setting of its valves. When the pump gets into motion, the main engine follows it in the same direction, and, by means of a loose eccentric, the timing of the entry of the fuel supply is adjusted to meet the conditions, whichever way the engine is running. The engine is thus reversible in itself, and will consequently drive the road wheels in either direction without the interposition of a mechanical gear. The compressed air pump affords a means by which the engine power can be momentarily increased to something approaching twice its normal figure. It is possible to start this engine, and get the whole machine under way, without touching the clutch.

There are, then, in this system, possibilities in the way of the removal of mechanical gears, the improvement of starting torque, and also, of course, the economy of fuel, which is cheap crude oil utilised under conditions that make for high efficiency. The engine of the existing machine runs normally at the low speed of about 300 revolutions per minute, with power to increase up to 450. It must not be assumed, however, that the pioneer of the Diesel-engined motor represents anything approaching finality. Engine speed may well be increased within limits. The tendency will no doubt be to produce smaller and smaller machines, and not to limit the application of the principle to heavy traction engines. It would appear that there are possibilities of the development of a semi-Diesel motor tractor or lorry, and it is possible that progress may lead to the introduction of the method sooner or later upon motor omnibuses and even upon lighter vehicles. In its present form the machine is far too heavy to be used under the regulations comprised in the Motor Car Acts.

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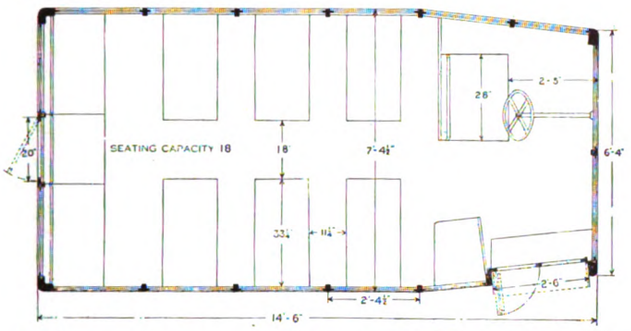
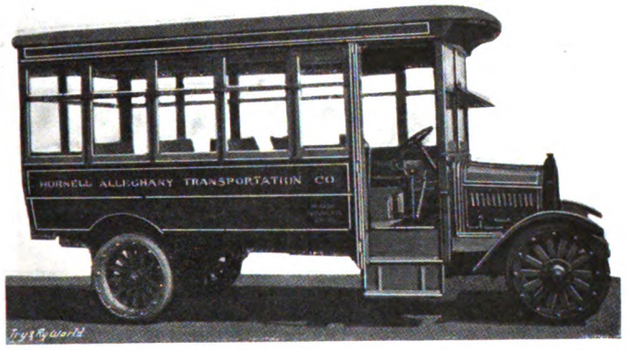
BRILL 3-TON OMNIBUS.

The J. C. Brill Company has supplied the omnibus illustrated on this page to the Hornell-Alleghany Transportation Company for service in South-Western New York between Alfred Village and Hornell, a distance of 11½ miles. The Brill body, weighing 2,400 lb., is mounted on a chassis, capable of carrying three tons, the weight of which is 4,800 lb. It has a wheel base of 13 ft. 9 in. The combined exit and entrance folding door is operated by the driver in conjunction with the bottom step, which folds, and the driver is able to collect the fares.



In the rear there is an emergency door, which can be used by removing the central part of the rear seat. The emergency door is controlled by the driver by means of a lever. The driver's seat is upholstered in leather, all the other seats being of twill woven rattan of Brill manufacture. The window-sashes are double, the upper part being stationary. A stationary hood directly in front of the driver serves to prevent the glass at that point becoming obscured.



Heaters are provided connected with the exhaust of the engine for warming the interior of the vehicle in cold weather. The interior is finished in ash, and the underframe is also constructed chiefly of ash. The vehicle is operated on a route which parallels the Erie Railroad, the terminus being a growing place with 15,000 residents. Three round journeys are made daily by the omnibus, a distance of about 70 miles. There is accommodation for 18 passengers.

STANDARD SOLID TIRE RIMS.—The Engineering Standards Committee, 28, Victoria Street, S.W., have issued a report of the sub-committee on British Standard Solid Tire Rim Diameters. They state that in "recommending the six standard sizes put forward by the Society of Motor Manufacturers and Traders we desire to point out that while the six sizes selected do not represent ideal dimensions advancing by even steps, they are the actual sizes in most general use in the automobile industry at the present time, and will enable the largest number of tire moulds now in existence to be used without alteration. It is hoped that in the near future it will be found possible still further to reduce the number of standard sizes, and with this object in view the committee recommend that two of the six standard sizes be dispensed with for general use. The committee hope at some future date to deal with standards for the solid tires themselves."

MOTOR MACHINE GUN SERVICE.—Sanction having been received for the formation of further motor machine gun batteries, Inspecting Officer Geoffrey Smith, 19, Hertford Street, Coventry, has re-opened recruiting. Experienced motor cyclists and a limited number of expert pedal cyclists with an aptitude for motor cycling are required.

ELECTRIC REFUSE WAGONS.

BIRMINGHAM CORPORATION ACQUIRE TWO VEHICLES.

Mr. J. Jackson, superintendent of the refuse disposal department, Birmingham, in a report to the City Council, states that the electric supply department have ordered two electric vehicles of the "Mossay" type, which are to be hired by the refuse department with a view to demonstrating to users of haulage vehicles as to their suitability for town work. The two vehicles will replace five horses and two four-wheel wagons in the Harborne district. Referring to three tests which were made in Birmingham with Edison vehicles, Mr. Jackson advocates an extended trial in the collection of house refuse for the following reasons :—

(a) The cost appears to justify an extended trial.
(b) In this city there are 275 horses engaged in connection with refuse disposal work. If "electrics" were adopted the number of vehicles would be reduced by half.
(c) All the refuse removed has to pass over a weighing machine, so that clerical labour would also be reduced to the same extent.
(d) The supervision by outside inspectors of half the number of vehicles should be either less expensive or more effectively performed.
(e) The expense of accidents, resulting from horses getting out of control and "moving on" whilst the dustmen are at the rear of the premises, would be avoided.
(f) The littering of the streets with horse manure, and the consequent expense of clearing same, would be considerably reduced, whilst the improvement and benefits resulting in tidier streets, especially in areas where the dwellings of the poor are close to the roadway, would undoubtedly assist in a reduction of "filth diseases."
(g) The electric vehicle can be lighted with metal filament glow lamps by current contained in the storage battery, and the superior light thus obtained would naturally reduce the number of accidents that now occur, in many cases, through the badly lighted horse-drawn vehicles.

"A horse and wagon in this city," says Mr. Jackson, "remove three wagon loads of refuse per day, which entails the vehicle stopping at approximately 150 houses per day. This at once rules out of court the petrol vehicle, which, as is well known, materially depreciates by repeated stoppages. Such is not the case with the electric vehicle, and this alone constitutes one of its main features in its adaptability for the work of refuse removal. The operation of the cars is quite simple, and the horse drivers could in most cases be readily trained to drive them." The trials in Birmingham have shown that 30 miles per day would be an ample distance to be covered.

From estimates supplied by the makers, and as a result of his own tests, Mr. Jackson presents the following comparisons :—

	First Cost.	Weekly Cost.
	£	£ s. d.
Mossay vehicle ...	780 ...	11 2 4
Edison vehicle ...	1,075 ...	11 1 1
Two horses and vehicle	250 ...	10 4 0

There is, he observes, a considerable difference in the first cost of the two vehicles, but the net financial results are approximately equal, and especially so if the capacity of the vehicles is taken into consideration. The Edison is rated to carry three tons, as against 2½ tons with the Mossay. To the Edison there is also attached an electrical tipping arrangement, in place of a hand-worked screw tipping gear, which is valued by the makers at about £50. Ironclad oxide batteries are to be used, and they will be maintained by the electric supply department in order to ascertain exactly the cost of upkeep. A reliable figure is expected to be obtained in two years, and the sinking fund to be set aside is estimated to be sufficient to renew the batteries.

LONDON FIRE BRIGADE EQUIPMENT.

The London County Council, on July 13, adopted a report submitted by the Fire Brigade Committee recommending the purchase of ten motor fire engines, seventeen escapes, and a lorry at an estimated cost of £23,665. In December, 1913, the Fire Brigade Committee submitted a scheme for the acceleration of the motor equipment of the brigade. This provided that £40,000 should be expended on the purchase of motor appliances in the present financial year, but on account of the war the amount was subsequently reduced to £20,000. The execution by Leyland Motors (1914), Limited, of the contract entered into early in 1914 for twelve motor engines, twelve motor escape vans, and a chassis for a motor instructional tender had been seriously delayed owing to war demands. Only five engines, five vans, and the instructional tender chassis had been delivered, and it was very uncertain when the remaining appliances would be completed. In these circumstances the amount charged against the sum of £26,100 provided in the capital votes for 1914-15 in respect of the purchase of motor appliances had amounted to only £11,540, leaving £14,560 unexpended. Since the decision of the Council to restrict expenditure on motor appliances during the current financial year it had become increasingly apparent that the efficiency of the fire brigade must be maintained at a high standard during the period of the war, and the present recommendation was therefore presented.

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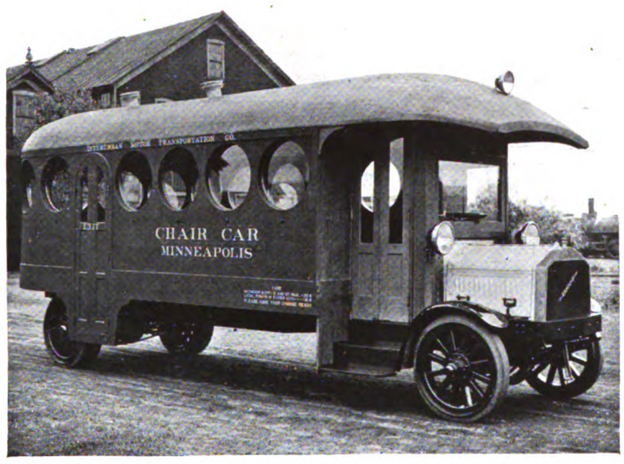
MOTOR TRAFFIC.

McKEEN HIGHWAY COACH.

"A highway coach to run on paved and macadam streets—the most comfortable, the most luxurious, the most exclusive and up-to-date means of transportation in urban or inter-urban passenger service." This is the attractive way in which the McKeen Motor Car Company, of Omaha, Nebraska, introduce to us the McKeen petrol motor omnibus, of which an illustration is given below. The vehicle is equipped with individual chairs, the chair being a "novel steel spiral spring, pneumatic shock-absorbing, cushioned seat for each and every passenger." This chair embodies all the cushioning effects of a 2 ft. spiral spring, and has four air-cushions operating in conjunction therewith, and differentiated on each other, the combination acting both as a cushion and shock absorber. The luxury, the freedom from jar, the pleasure of this chair, we are assured, cannot be appreciated except by personal experience. In a word, adds our correspondent, the car is guaranteed to afford the most easy riding method of transportation known to man." After this we are confident that our readers will *en masse* demand further details, and we cannot do better than let the enthusiastic manufacturers provide these in their own words. They write:—The design and construction of this highway coach embraces all the meritorious features of the McKeen railway motor car, which has



New American Design for Petrol Omnibus.

in the last ten years made such signal success on railroads. All the hygienic and attractive details of the superstructure, as well as the ventilating, heating, and sanitary facilities are the same on the highway coach as on the railway gasoline motor car, important among which are plate-glass, air-tight round windows affording an almost uninterrupted panoramic view in all directions. The window when open is hinged to the ceiling, and gives a full opening or circle of 24½ inches, and enhances the pleasure of riding during the high temperatures of the summer weather. Exhaust suction ventilators on the roof maintain constant circulation and removal of the air, thereby keeping the coach free from foul atmosphere, a hygienic accommodation long desired by the urban traveller. The elegance of the Cuban mahogany interior siding in combination with the white enamelled arched ceiling is particularly attractive. The car is electrically lighted, and between each two windows is an electric push-button for convenience of passengers in signalling the driver. The door operating mechanism is controlled by the driver.

Entrance to the car is gained through a two-leaf outward folding door beside the driver's position, the prepayment fare collection being under his supervision. Exit is through double-leaf outward folding door in the side near the rear.

Instead of a high step from the road, the passengers take this car at the curb (the coach entrance being only 15 inches from the ground, the initial step is about 7 inches), thereby avoiding the congestion in the streets and hazards of street traffic, as stepping into the highway coach does not in any way interfere with the passing of horses, wagons, motor-cycles, automobiles, electric cars, and other traffic on the highway. This car takes the passengers on one side only, and from the sidewalk.

Adequate heating facilities for the car are obtained from the waste product of the petrol engine, there being twice the necessary heat units available for maintaining the proper temperature of the interior of this car in the coldest of winter days. With this large supply of waste heat there is no additional expense in providing the passengers with plenty of moderately heated fresh air, thus the best of atmospheric conditions can be maintained in this car at practically no expense whatever. This feature alone will be a source of attraction, for a great many people who have been closely confined in offices during the day will be only too glad to receive the exhilarating effect of warm fresh air in their conveyance on the trip home. The chassis of the coach is a 3½ ton truck, having a wheel base of 216 inches; the length of the frame behind driver's seat is 22 ft. The first two of the McKeen coaches will be operated between Minneapolis and St. Paul, Minnesota.

"Mr. McKeen," we are informed, "has the round window, spring pneumatic-cushioned chair, etc., covered by patents, making it impossible for these exclusive and very important features of the McKeen highway coach to be copied by other builders."

GAS COKE FOR STEAM MOTORS.

Following the successful use of gas coke in steam omnibuses in London, a London Coke Committee has been formed to promote the use of gas coke for fuel purposes. A booklet has been issued from 84, Horseferry Road, Westminster, S.W., giving the results of tests carried out by the Royal Automobile Club with steam vehicles using gas coke. Much other interesting information is given. Many of the leading wagon makers like Leyland, Yorkshire, Sentinel, and National, send out their wagons equipped to develop their full capacity on coke fuel, and Fodens, Garretts, and similar (locomotive) type machines may be fitted up at trifling cost to use the cheaper fuel. A 5-ton Foden so fitted (at a cost of 10s. 6d.) is hauling 12-ton loads with trailer on country roads on coke exclusively.

Compared with bituminous coal, gas coke, which contains only about 2 per cent. volatile matter and about 5 per cent. hydrogen, as against 25 per cent. and 5 per cent. respectively, is a much more efficient fuel. Its low hydrogen content and intense radiant characteristic renders it an ideal fuel for boilers of the locomotive type in which the fire-bar area forms the chief evaporative surface. On road locomotives and stationary locomotive boilers coke fuel is used extensively, but the committee are not aware that it has been used on railway locomotives outside a gas works.

At the present time, when coal economy is of great importance, the use of coke might with considerable advantage be extended to railway locomotives hauling local trains of the Shuttlecock description, and the committee would be pleased to institute trials in this direction if arrangements could be made with one of the local companies.

COVENTRY CORPORATION OMNIBUSES.

In the report of Coventry Tramways Committee for the year ended March 31 last, the following reference is made to the interrupted motor omnibus service:—"The motor omnibus service which was inaugurated on March 30, 1914, ceased on September 6, 1914, owing to the chassis of the omnibuses being commandeered by the War Office. The borrowing powers in respect of motor omnibuses amount to £15,180, of which only £1,500 has been exercised. The total capital expenditure (including £180 provided out of revenue) has been £1,666. The traffic revenue for the six months during which the omnibuses were running was £3,440, and there was in addition a revenue of £33 from advertising rights, bringing the total up to £3,473, equal to an average of 9·165d. per 'bus mile. Working expenses amounted to £2,739 (equal to an average of 7·229d. per mile), so that there was a working profit of £734 for the six months. Capital and other special charges were as follows:—Interest on capital, £122; contribution to sinking fund, £49; grants to dependents of men serving with the colours, £2; costs and expenses, in connection with the Corporation Act, 1913, £180; total, £353. There was therefore a net profit of £380, which was carried to the general appropriation account. In considering the above figures, it must be borne in mind that the omnibuses were in operation during the best traffic period of the year. Even then, the average total earnings were only 9·165d. per mile, and this figure would probably have been reduced had the service been continued through the winter months. Moreover, the cost of repairs and maintenance per omnibus mile would also have increased in proportion to the expired life of the vehicle. The mileage run by the omnibuses while in service was 90,954, and the number of passengers carried at the different fares was:—1d., 474,849; 1½d., 213,961; 2d., 1,481; 2½d., 8,118; total, 698,409. The original cost of the six omnibuses was £4,434, and the amount paid by the War Office in respect of the six chassis was £3,564." The net profit for the year on the omnibus account was £380.

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MOTOR TRAFFIC.

MOTORS FOR SANITARY WORK.

Papers relating to the use of horse and motor traction for cleansing work were read at the annual conference of the Institute of Cleansing Superintendents, held in London.

Mr. W. H. HAMBLETT, of Salford, presented returns obtained from 23 towns, which showed that there is lacking a strong and definite lead that the horse could be altogether disposed of in relation to street cleansing. The horse could still be found useful and economical in "pick-up work." In street watering and sweeping the necessities of the work were best met by motors, but in the collection of house refuse horses seemed to be most economical. In tipping the refuse at long distances there was room for the employment of motor vehicles and spare bodies to receive loads tipped from horse carts. A scheme on the latter lines was worked very satisfactorily at Aberdeen until the military authorities requisitioned the motors. In Salford, although the distance between the dust destructor and the tip was 2½ miles, motor haulage had to be given up in favour of horses.

Mr. F. W. BROOKMAN, of Rochdale, gave a description of the steam, petrol, paraffin, petrol-electric, battery, and coke-fire wagons. He urged superintendents to watch the results of motors in towns comparable with their own. In the case of the sweeper, there was an instance where a motor sweeper more than paid for itself in a year. In Blackpool a seven months' test of a Laffly motor sweeper showed a saving of £634 in seven months.

In the course of the discussion, Mr. W. HARPER (Cardiff) said there was useful work for both horses and motors.

Mr. PARKINSON (Liverpool) presented figures proving that horses must be used to some extent for economy, but said it was not right to refuse to use motors.

Bailie MITCHELL (Glasgow) said Glasgow had five Laffly, one Green, and one Lacer motor sweepers. The Laffly machines were covering during the night from 45 to 48 miles in eight or eight and a half hours. Electric machines would replace steam and petrol wagons in a few years time.

Mr. J. B. HAMILTON, commercial manager to Leeds Corporation and general manager of the tramways department, stated that although Leeds was the first to begin with motors for street work, they were not yet able to give reliable data for initiating a great movement in favour of motor traction. The question of depreciation had not yet been settled. Already in Leeds they had what might be termed one of the old masters, although only five years old. As a believer in science, he thought that the near future would see such improvements in mechanical traction as would meet the changing conditions which faced them to-day. The electric vehicle would be the ideal vehicle for their work in the future. In many places destructors could be used to generate electricity, and he did not think it was too much to ask municipalities to provide in the near future vehicles the cost of which would be reduced by the working of the destructors. At the end of the war horses would be very scarce, wages very high, and they would have to look forward to adopting mechanical traction.

Mr. W. GRIEG (Glasgow) said the motor sweepers in that city were operated at a cost of from 6·50d. per mile, including repairs and depreciation, while horse traction cost 10d. The quality of the work was altogether in favour of motor vehicles.

COMMER CARS IN FRANCE.

Reference to the work of Commer cars in France was made at a dinner to the management of Commercial Cars, Limited, given on July 21, at Luton, by the chiefs of the various departments in the factory. The guests were Mr. H. Underdown, chairman and managing director; the Hon. Wilfrid Egerton and Mr. L. G. Jaekel (directors), Mr. J. E. Davies (secretary), and Mr. E. L. Coxhead (works manager). During the proceedings Mr. Underdown mentioned that Mr. Wing, M.P., had recently visited Luton on behalf of the Parliamentary Munitions Committee, and had congratulated the firm on the way it was carrying on its work for the War Department. Mr. Thomas, their chief engineer, who had just returned from a visit to the various depots in France, reported that Commer cars were doing extremely well, and a great number of them were right at the front. In fact, there were hundreds in all parts of France helping the country. Mr. Underdown read some extracts from letters received from drivers of the company's cars testifying to the excellent work of the vehicles.

ROAD BOARD GRANTS.—The grants made to local authorities by the Road Board during the three months ending June 30 totalled only £109,903.

COMMITTEE ON HEAVY MOTORS.

Appended is a copy of the first schedule issued by the Commercial Motor Users' Association (Incorporated) for the collection of information to lay before the Local Government Board Committee on Road Locomotives and Heavy Motor Cars. Individual returns will be regarded as strictly confidential. The returns will be combined with others and the general results will alone be used.

1. How many commercial motors, etc., do you possess?
2. Give details of any action by the Police or Local Authorities calculated to discourage the use of commercial motors.
3. Give details of any roads which you have regularly worked which have stood up to your traffic, without damage.
4. Have you been threatened with a claim for alleged extraordinary traffic; if so, give details?
5. Give exact particulars of any instance of injustice resulting from the present law and regulations affecting commercial motors.
6. Do you consider a governor actuated off the back axle or propeller shaft acceptable as an alternative to the reduction of the present axle-weights?
7. Are you, if a petrol vehicle owner, reconciled to the present scale of taxation, and, if a steam vehicle owner, what annual basis of taxation do you regard as the least obnoxious?
8. Have you any objection to the universal requirement of rubber tires?
9. If steel tires are retained, are you agreeable to a higher scale of taxation than for rubber tires?
10. Should the evidence of the C.M.U.A. *re* steam wagons and tractors be based generally on the expectation of no taxation (which is almost hopeless), or on the acceptance of reasonable taxation, coupled with exemption from the risk of claims for road damage?
11. If taxation of steam wagons and tractors is inevitable, what gradation or system do you suggest?
12. Do you approve of higher rates of taxation, if axle weights above 8 tons can be sanctioned by law, and what is such excess worth?
13. Which of the existing regulations appear to you to call for alteration, and how?

FODEN STEAM TRACTORS.

An appeal by E. J. Jeffery, the driver of a Foden steam tractor, against a conviction by the Great Torrington Justices was heard at Devon Quarter Sessions on June 30. Appellant was summoned and fined 21s. and costs for having caused a locomotive to enter a highway for a continuous length exceeding 100 yards and of a width of less than 16 feet without having first ascertained that such highway was clear of vehicles, and not having a person preceding such locomotive to warn drivers of vehicles of its approach. The prosecution said the only question was whether it was a locomotive under the Act of 1898, or whether it came within the exemption provided by the Light Locomotive Act, 1896. If it was within the latter Act, the question was whether it was so constructed that no smoke or visible vapour was emitted therefrom, except from temporary or accidental causes. The Torrington conviction is the only instance recorded during the thirteen years Foden steam wagons have been in use, and by all other authorities administering the Act in 51 counties it is regarded as a light locomotive. There are 3,000 of them in use. Evidence was given on behalf of the appellant by Col. Crompton, C.B., who was in charge of mechanical transport during the Boer War, and is now engaged at the War Office in organising mechanical transport; Mr. M. F. Ryan, assistant locomotive engineer of the London and South Western Railway; Mr. T. Davis, consulting engineer to Foden, Limited, and expert adviser to Liverpool Tramways Committee; Mr. Bailey, C.E.; and Mr. Squire. The court allowed the appeal without costs.

EASTBOURNE CORPORATION OMNIBUSES.

During the year ended March 31 last the income of this department was £10,537, of which £15,075 was received from passengers, the total income being equal to 14·77d. per car-mile, as against £15,946 and 14·64d. the previous year. The expenditure per car-mile was 12·02d. on an outlay of £13,457, as compared with 12·52d. for the preceding year. Included in the expenditure was £1,144 for instalments on omnibuses purchased out of revenue, equal to 1·02d. per car-mile. Repairs and maintenance account for £1,903 (1·7d. per car-mile), as against £2,092 (2·75d. per car-mile). Six Leyland chassis were requisitioned by the War Office, which paid £3,574 for them. There are no instalments of debt owing on the remaining vehicles. There was a considerable loss of income during the season, which was interrupted by the war. As yet it has not been possible to replace the impressed vehicles. More than forty of the employees are serving with the colours.

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MOTOR TRAFFIC.

MOTOR TRAFFIC NOTES.

ELECTRIC DUST VAN.—Leyton Council have directed a sub-committee to consider the question of purchasing an electric dust van.

OMNIBUSES AT BRADFORD.—In the next Bill promoted by Bradford Corporation additional powers are to be sought for running motor omnibuses.

G.W.R. MOTOR DEPARTMENT.—Of 210 members of the Great Western Railway staff in the motor department at Slough, 67 have joined the colours.

MOTOR DELIVERY FOR OLDHAM PARCELS SERVICE.—The Tramways Committee have advised the Corporation to purchase a Ford motor van for the parcels delivery service

SCHOOL TREATS BY OMNIBUS.—Owing to the inability to obtain trains for the seaside, 500 children of a Clapham Sunday School and 200 mothers were taken for a treat in motor omnibuses to Bricket Wood, Herts.

MORE OMNIBUSES REQUISITIONED.—North Wales Silver Motors, Limited, have informed Chester Council that the motor omnibus service to Kelsall has been discontinued, as the military authorities have requisitioned nearly all of the vehicles.

NATIONAL ROAD EXHIBITION.—The firms that recently exhibited at the National Road Exhibition have informed the County Councils Association that as soon after the war as is convenient they would welcome the holding of a similar exhibition.

AN EDISON BATTERY GUARANTEE.—Edison Accumulators, Limited, who have supplied an electric coal wagon to Ilford Council, have guaranteed that the battery will retain its original rated capacity when the vehicle has traversed 60,000 miles.

NEW MATERIAL FOR ROAD SURFACES.—Nicephalt grouting is to be supplied and applied at the expense of Highways Construction, Limited, to a small area of macadam roadway in Exhibition Road, Kensington, in order to demonstrate its value in improving such surfaces.

MOTOR CHASSIS FOR PORTSMOUTH TRAMWAYS.—Two motor chassis, purchased at a low price in London, have been brought into use by Portsmouth Tramways Department. A lorry body for coal cartage has been fitted to one chassis, and on the other the body of the horsed tower wagon has been built up.

OMNIBUSES WANTED AT COVENTRY.—Councillor Pugh, in submitting the Tramways Committee's annual report to Coventry Corporation, stated that the motor omnibus service came to an end owing to the vehicles being impressed by the War Office. As yet it was impossible to obtain fresh vehicles from any source whatever.

THE WOOD-MILNE COMPANY claim to have effectively remedied that frequent source of tire trouble, the leaky valve patch. The latest Wood-Milne tubes are fitted with a patent embedded valve patch, which is vulcanised in flush with the tube. It is therefore an integral portion of the tube, and cannot possibly shift or become loose. No extra charge is made for tubes so equipped.

MOTOR VEHICLE TO AVERT TOWER WAGON DELAY.—Owing to rain penetrating the insulation of a cable on the Marefair and Abington Road line, Northampton, traffic was stopped for an hour on July 16. The delay was also contributed to by the interval which elapsed before horses were forthcoming for the tower wagon. In future this will be averted, as a motor tower wagon is being provided.

L.G.O. STILL SUPPLYING WAR OFFICE NEEDS.—In a recent issue it was stated that the London General Omnibus Company were manufacturing some omnibuses to take the place of vehicles impressed by the War Office. At present, however, this is not the case, as the whole output of the Walthamstow factory is being taken over by the Government, and no part of it is available for increasing the stock of omnibuses for London.

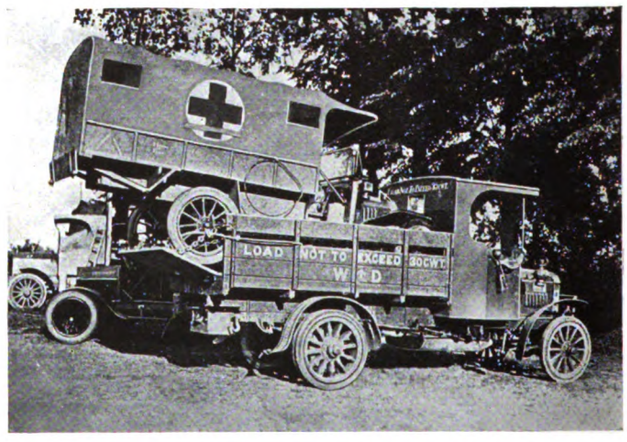
MOTOR VOLUNTEERS AT CARDIFF.—Alderman Sir John Courtis is the commandant of the company of the National Motor Volunteers which has been sanctioned at Cardiff by the War Office. Sir John, who is chairman of the Tramways Committee, and Lady Courtis have presented the Lord Mayor with one of the six motor ambulances which his lordship is appealing for in order to transport wounded soldiers now in hospital in the district.

AN OPENING FOR BATTERY VEHICLES AT MANCHESTER.—The receipts of the parcels department of Manchester Corporation Tramways during the past year were £13,571, yielding a net profit of £3,639. Per week the average number of parcels is 23,779. The profit should be considered large enough to permit of an experiment being made with the electric battery vehicle. Horsing expenses totalled £934, and the maintenance and depreciation of vehicles £185.

MOTOR CARS FOR MUNICIPAL DEPARTMENTS.—Bradford Council on July 13 referred back to the Water Committee a recommendation for the provision of a motor car and a driver for the use of the water department. It was suggested that instead of every head of a department having a private car a municipal garage should be established to provide for the needs of all departments. This matter might well be taken up by the Electricity Committee with a view to the adoption of battery vehicles.

TILLING-STEVENS OMNIBUS FOR WALSALL.—Walsall Council have agreed to purchase a Tilling-Stevens omnibus for the Tramways Department at £1,250. After the first contract for omnibuses was placed the military authorities appropriated the vehicles before delivery. There was a like result to a second contract. Under a third contract two conveyances were delivered, but Messrs. W. A. Stevens, Limited, intimated that as the Government had taken over their works they could not at present execute further orders beyond the above vehicle.

BIRMINGHAM AND MIDLAND MOTOR OMNIBUS COMPANY.—The accounts for 1914 show a profit, including £169 brought forward, of £13,506. The directors recommend the transfer of £7,700 to sinking fund for redemption of debentures, and the payment of a dividend of 5 per cent. on the preference shares for the period under review, carrying forward £163. The arrears of dividend on the preference shares have been cancelled up to December 31, 1913, and the rate of dividend on the same has been raised from 5 per cent. cumulative to 6 per cent. non-cumulative.



Dennis Lorry Carrying Disabled Red Cross Van at the Front.

BRITISH AUTOMOBILE TRACTION COMPANY.—In their report for the year ended December 31 the directors of the British Automobile Traction Company state that the net profit receipts after providing for depreciation amounted to £20,658. A surplus of £11,100 is shown, making, with the balance brought forward, £11,325, which the directors propose to appropriate as follows:—Reserve £2,000, dividend on ordinary shares at the rate of 8 per cent. per annum £5,075, carrying forward £4,248. The war resulted in the impressment of a large number of vehicles, but expenses had been reduced to meet the altered position. The company during the year extended existing services and acquired interests in new districts.

PAYMENT FOR OMNIBUSES BY INSTALMENTS.—On the recommendation of the Tramways Committee, Rotherham Corporation has decided to obtain three motor omnibuses at £959 each from the Scottish Commercial Cars Company, Limited. Alderman Winter, the chairman of the committee, stated that the vehicles were to be bought on what was called the hire purchase system. The interest of 6 per cent. would not be more than they would have to pay for interest and sinking fund on capital account. In course of time further omnibuses would be necessary in order to meet the wants of the localities which were named in the Bill recently obtained from Parliament. Four vehicles running now were inadequate to meet the needs of the borough and of the districts of Catcliffe and Treeton. It was intended to take in Aughton, Aston, Swallownest, and other places.

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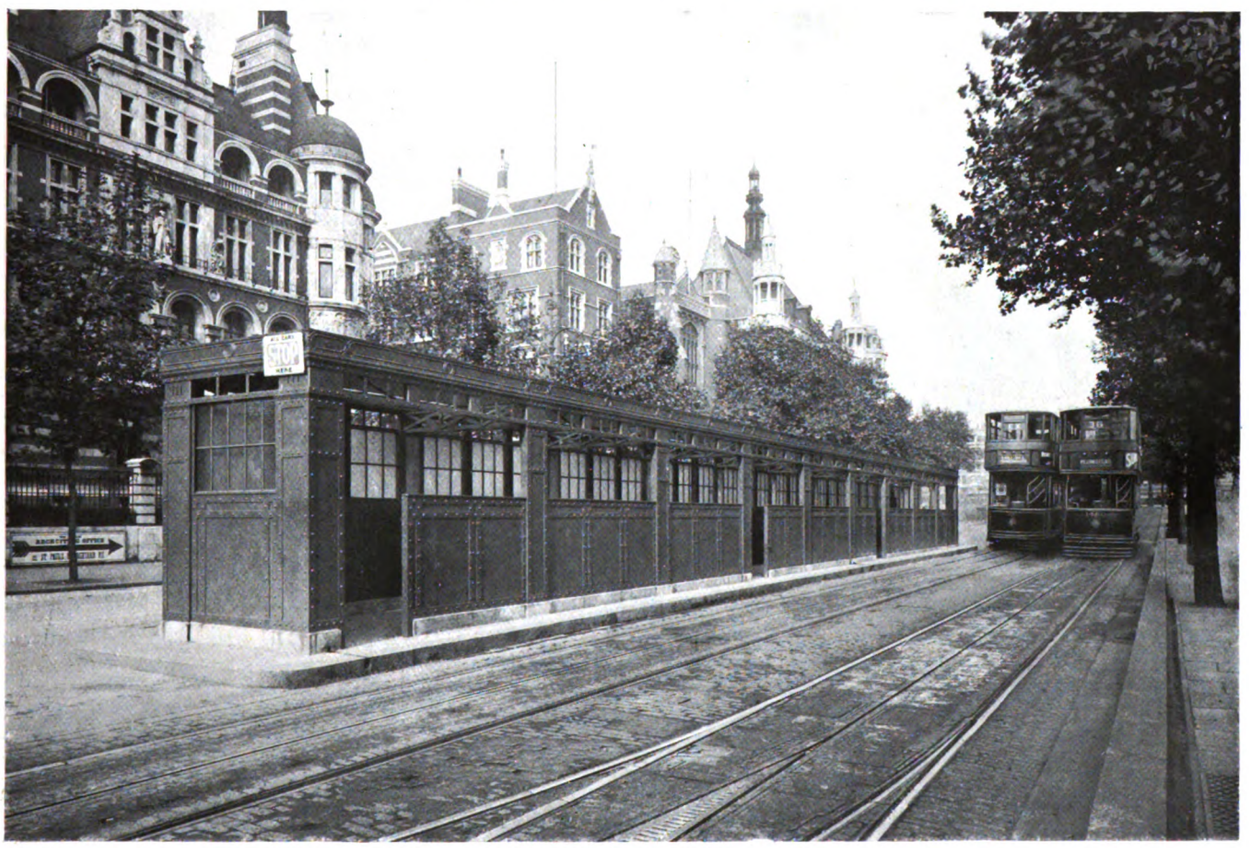
THE Tramway & Railway World
WITH MOTOR TRAFFIC SECTION

Founded 1892. LONDON, SEPTEMBER 9, 1915. VOL. XXXVIII.

TRAMWAY SHELTERS IN LONDON AND GLASGOW.

A very short time after the opening of the first sheltered queues for tramway passengers at the Blackfriars Bridge end of the Victoria Embankment in London at Easter, 1911, the need was felt for additional accommodation. The six lines of passengers that converge from the entrances at each end of the structure to the central openings, from which they pass to the cars, at times extended from 20 to 50 yards or more beyond the roof. This shelter is the arrival and departure point of a large proportion of the many thousands of workers engaged in the City of London. The business man and the factory girl are prominent among them, and before the structure was erected they had to take their chance in undignified and dangerous rushes to the cars. To a lesser extent the scramble still prevails at other points along the Victoria Embankment, notably at Waterloo Bridge, Charing Cross, and Westminster Bridge. Waterloo Bridge and the South-Eastern Railway Bridge over the Thames at Charing Cross provide protection from rain at those places, and at Westminster there is a small shelter far back on the foot pavement. Further west, at the Victoria Street end of the Vauxhall Bridge Road tramways there is at present neither regulation of the passengers nor a shelter for them. At these points the traffic may not be heavy enough to require the same arrangements as at Blackfriars, but at Victoria a shelter at least is necessary. Failing that course, the barrier system might be adopted, as is the case at Southwark Bridge, as soon as the reduction of the staff entailed by the war can be made good.



New Shelter for Passenger Queues near Blackfriars Bridge, Victoria Embankment, London.

From the points of view of the convenience and comfort of passengers, as well as utility in expediting the loading of the cars and speedily despatching them upon their journeys to the suburbs, the Blackfriars shelter has more than justified the enterprise shown by the management of the London County Council Tramways and the Highways Committee who guide the policy of the Council. Acknowledgment must be made of the co-operation of the City of London

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Corporation in granting the use of a portion of the roadway for the erection of the shelter. The same readiness to study the welfare of the public was manifested by the Corporation when the County Council approached them last year in order to secure sanction to the construction of a second shelter. This has now been completed and was brought into use a few days ago. It is situated 260 ft. west of the old shelter opposite the City of London School, and is just over half as long as the first building, viz., 97 ft. 6 in., as compared with 180 ft. The refuge on which it stands is 105 ft. in length and 10 ft. broad, while the width of the shelter itself is 6 ft. 11 in., the width of the first one being 8 ft. 10 in. The new structure is 8 ft. 6 in. high.

Steel and cast iron are the materials used in its construction, and their adoption will enable an interesting test to be made with metal as against oak, which was wholly utilised for the first shelter. While in the deleterious atmosphere of London steel and cast iron will need frequent painting to ensure preservation, that necessity will ensure the steel and iron building presenting a brighter appearance than the oaken one. Apparently the latter would soon revert to a dingy hue, even were it varnished quarterly. The roof is constructed of patented glass, with a special form of metal bar. On the river side the shelter is open above the height of a passenger's shoulders, and on the north side it is closed in with sashes to prevent the drifting of rain and splashing from the passing traffic.

Although the roadway is asphalted, the motor traffic at the rush hours is so frequent and rapid that the splashing it creates needs to be guarded against. The floor of the refuge and shelter is constructed of granolithic paving, which will give a firm foothold, and it is bordered with granite kerbing. The interior dado of the wall is lined with boarding to prevent passengers' clothing catching in the uprights. At night the shelter and route indicators at the entrances will be electrically illuminated. The division of the interior is of sheet iron to prevent pocket picking. Messrs. A. Roberts and Company, Limited, of Chelsea, were the contractors for the erection of the building, and the glazing was supplied by the Luxfer Prism Syndicate, Limited. Both the old and new shelters were designed by, and constructed under the oversight of, Mr. W. E. Riley, the superintending architect to the London County Council.

Illustrations are given of both the new and the old shelters. The former accommodates six cars alongside of the single line on which loading can only be carried out. The new erection will take three cars, an equal number of outlets and queues for passengers being provided in the shelter. Entrance will be gained on the east end only, from which direction most of the passengers come, and the interior is arranged in such a way as to distribute the crowd to the three cars at any of the three exits. The wider queue at the rear leads to the centre exit. A space of 45 ft. on the west end of the site granted by the City Corporation has been reserved for a future extension. If it is made it may involve the removal of the cross-over shown in the illustration to a position further west. In conclusion, it is only necessary to add that the shelter will greatly increase the comfort of the passengers and lead to a considerable speeding up of the traffic.

A Notable Structure at Glasgow.

In response to an advertisement in the *Glasgow Herald* in April last year for competitive designs for a tramway shelter proposed to be erected at the junction of Grange Road and Battlefield Road, twenty-nine different designs were received. These were submitted to the members of the City Council, who, after careful consideration, gave their decision in favour of the design sent in by Messrs. Frank Burnet and Boston, 180, Hope Street, Glasgow.

First Tramway Shelter at Blackfriars, Victoria Embankment, London.—This Structure is to the East of the New Shelter.

The waiting-room, which occupies the centre or main portion of the building, measures 40 ft. by 25 ft. Lavatory accommodation is provided at the north end of the building, and the south end is fitted up with a neat and attractive newsagent and confectioner's shop, surmounted by an octagonal tower with gilt dome. The external walls are faced with Doulton's Carrara ware. The roof is finished with red tiles, and the woodwork is of red pine throughout. The total cost was approximately £1,800. For the accompanying illustrations of the new structure we are indebted to Mr. James Dalrymple, the general manager of Glasgow Corporation Tramways.

Councillor R. Kirkland, chairman of the Tramways Committee, declared the shelter open a few days ago, when he announced that it was part of a scheme for erecting shelters for tramway passengers at various parts of the tramway route. No further structures, however, would be erected while the war lasted.

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Views of the New Shelter at Grange Road and Battlefield Road, Glasgow Corporation Tramways.

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PENNSYLVANIA RAILROAD ELECTRIC LOCOMOTIVES.

NOTABLE PERFORMANCE DURING FOUR YEARS' SERVICE.

The Pennsylvania Railroad has recently permitted the publication of some interesting and arresting figures covering the performance of the electric locomotives used by the company on their Manhattan Division for working passenger trains through the tunnels entering New York City under Hudson River. These locomotives have been in use for nearly four and one-half years, and the data given below represents their performance during the period in a very striking manner.

They were designed to start and accelerate a 550-ton train, in addition to the locomotive, on a 1·93 per cent. gradient in tunnels, but in actual operation, 850-ton trains are frequently started on this grade, and trains of 14 all-steel cars, weighing over 1,000 tons, are handled without difficulty.

Each locomotive in service passes over an inspection pit every 24 hours, when a running inspection of machinery is made similar to that given steam locomotives over the pit, when slight repairs are made as necessary. The average time required for this inspection is approximately ten minutes. After 3,000 miles' run, the locomotives are taken into the shop for a general or periodic inspection, when all electrical apparatus is thoroughly gone over, tested, cleaned, and necessary adjustments and renewals made to all electrical and mechanical parts. Tire wear is the immediate cause of these locomotives being sent into the shops for general repairs, and a number of locomotives have run from 90,000 to 112,000 miles before it was necessary to turn the tires or do any general repair work. The general overhauling and repairing of these locomotives is done in one of the regular steam locomotive repair shops.

At Manhattan Transfer, west of the Hudson River, where the change is made from steam to electric locomotive on trains to and from the Pennsylvania station in New York City, the time allowed per schedule for making the change, including necessary testing of air brakes, is four minutes, although the entire operation can be performed in three minutes, and has been done in two minutes

These locomotives, as will be seen from the illustrations, are articulated machines, each consisting of two

Unit Electric Locomotive of Pennsylvania Railroad.

semi-units permanently coupled together, each semi-unit having a four-wheel bogie-truck and two pairs of driving wheels connected by side-rods, the semi-units being permanently coupled together at the driving wheel ends. The locomotive frames, trucks, and running gear are similar in general character to the standard American type steam locomotive and the relation of the working parts on the two semi-units is similar in location to two steam locomotives coupled back to back.

Typical Electric Locomotive and Train of Pennsylvania Railroad running into New York under Hudson River.

On November 28, 1914, 33 electric locomotives had completed four years' service, and during that period the mileage and detention record is as follows :—

Locomotive-miles	3,974,746
Total engine failures	45
Total minutes detention to trains	271
Locomotive-miles per detention...	88,328
Locomotive-miles run per minute of detention...	14,667

During this period, 463,558 train movements were made, or an average of 1,300 movements per detention due to engine failures.

Each semi-unit is equipped with 2,000 H.P. motor connected to the driving wheels through a system of parallel rods and cranks with an intermediate shaft, and is fitted with unit switches, master controller, Westinghouse automatic and straight air-brake apparatus, electric headlight, pneumatically-operated whistle, sand apparatus, and other items of less importance. The locomotive equipment is so arranged that in the event of one motor being cut out of service, the entire locomotive can be worked from the other cab with the remaining motor. The unit switch control permits

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two or more locomotives to be coupled and all to be controlled from either end of any cab. The semi-units are interchangeable, and if any two semi-units are separated, they can be combined with any other semi-units, as may be required in making repairs, or for other reasons. The controllers are fitted with four running notches, giving great flexibility of speed regulation, and permitting the most economical use of power during acceleration.

Each motor has a continuous rating of 1,000 and a maximum rating of 2,000 H.P., or a total of 4,000 H.P. per locomotive. The motors are of the direct-current, field-controlled commutating-pole series type. The weight of each motor complete, including cranks, is 43,000 lb. The motors are supplied with direct current at 650 volts from the third rail, through contact shoes, located on either side of each truck. The motors, control, and the complete electric equipment was furnished by the Westinghouse Electric and Manufacturing Company, while the locomotives were built by the Pennsylvania Railroad in its own shops at Altoona.

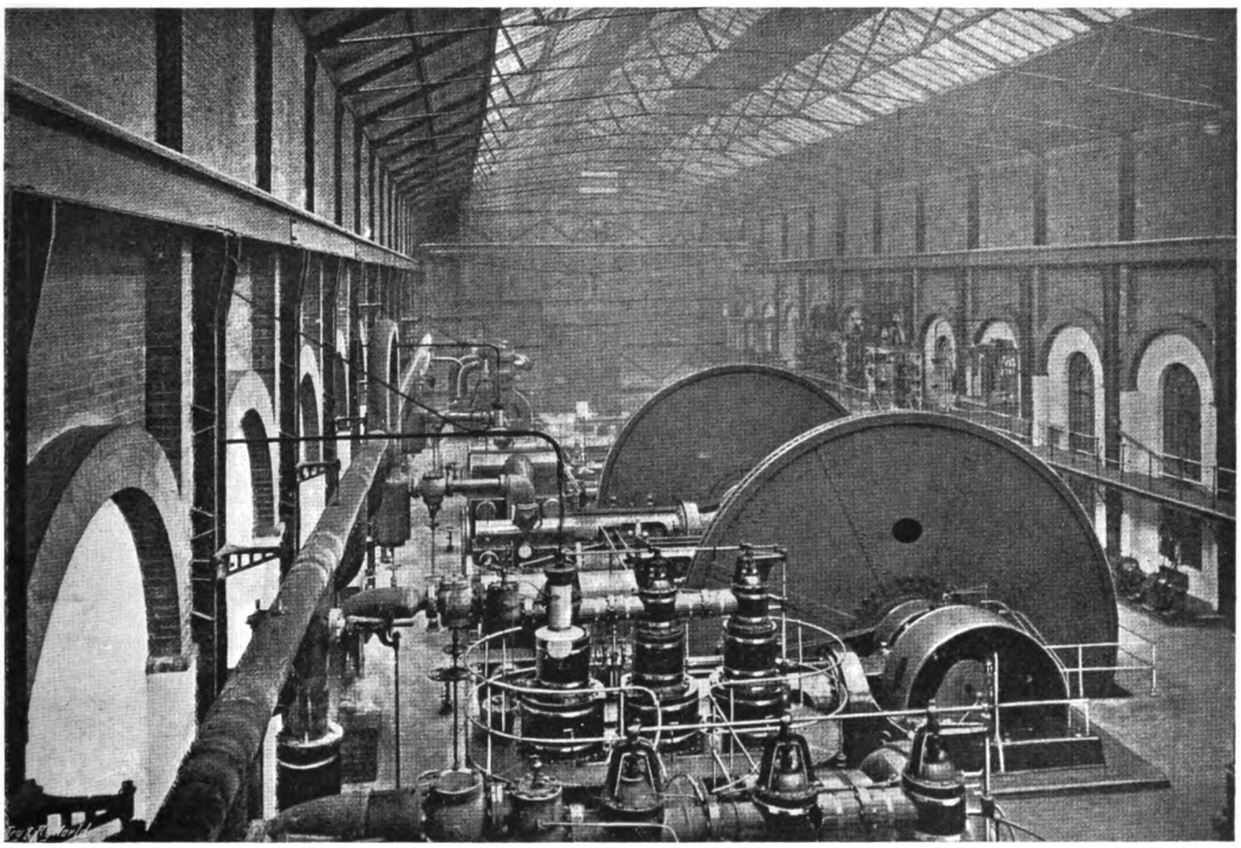
The rated tractive power of each locomotive is 66,000 lb., but in actual service 79,200 lb. has been registered. The weights and dimensions of these locomotives are set out below :—

Weight of locomotive complete	156.5 tons
Weight per driving axle	49,750 lb.
Total weight on drivers	199,000 lb.
Weight on each truck	57,000 lb.
Total length overall	64 ft. 11 in.
Rigid wheel base of each semi-unit	7 ft. 2 in.
Total wheel base of each semi-unit	23 ft. 1 in.
Total wheel base of each locomotive	55 ft. 11 in.
Total height of locomotive	14 ft. 8½ in.
Total height of cab	13 ft 1 1/16 in.
Total width of cab	10 ft. 8¼ in.
Diameter of drivers	72 in.
Diameter of truck wheels	36 in.

POWER SUPPLY OF LONDON UNDERGROUND RAILWAYS.

More Work for Chelsea Power Station.

Preliminary arrangements are being made to supply the Central London Railway with electrical energy from the Chelsea generating station of the London Underground Railways. A similar change was made in June in the case of the City and South London Railway. These changes are a part of the general scheme for consolidating and co-ordinating the working of all the lines which are associated with the Underground Electric Railways Company of London. As is well known, the station at Lots Road, Chelsea, had previously supplied the Metropolitan District Railway and the three tube lines of the London Electric Railway Company.



Engines and Generators, City and South London Railway.

To carry out the transfer in the case of the Central London Railway does not involve a great deal of work. The three-phase alternating-current system of distribution to sub-stations has, of course, been in use on this railway from the first, and now the supply of energy on the same system will come from Chelsea instead of from Shepherd's Bush. The power-station at the latter place will be superseded. High-tension cables from Chelsea will, of course, have to be connected. The supply from Lots Road, Chelsea, however, is at a pressure of 11,000 volts, while the voltage used at Shepherd's Bush is only 6,000. It is probable that transformers will be installed at the latter place to reduce the pressure of the Chelsea supply to 6,000 volts, and in this way the transformers in the sub-stations will require no alteration. There is also a difference in the periodicity of the two supplies, that of Chelsea being 33⅓ cycles per second, while Shepherd's Bush

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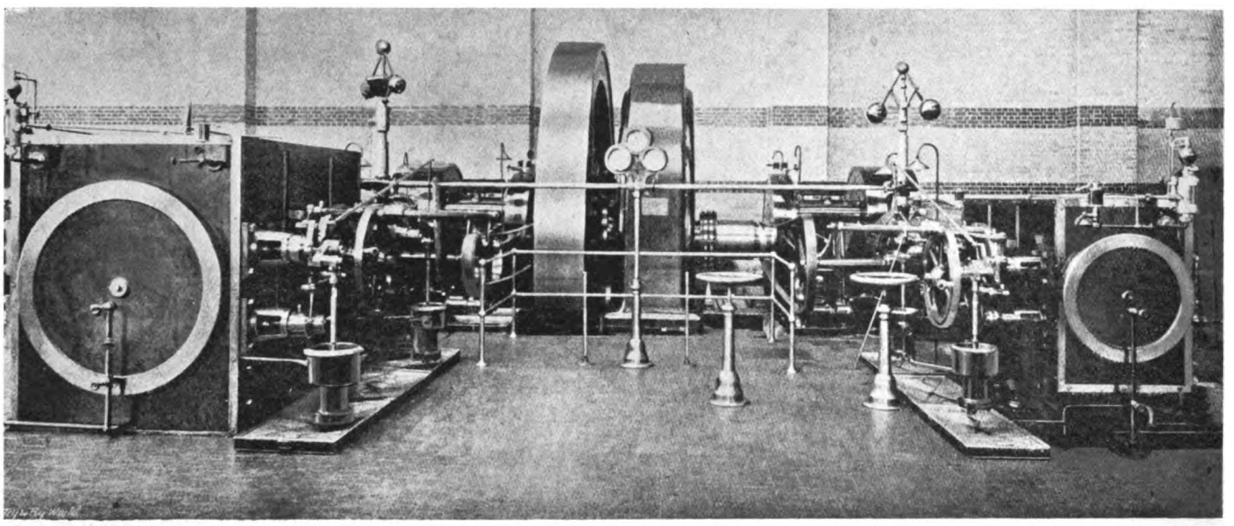
works at 25 cycles. It will accordingly be necessary to make some modifications in the rotary converters in the Central London sub-stations in order to adapt them for the higher frequency. Beyond these changes it does not appear that any alterations of importance are necessary.

The plant at Shepherd's Bush station, which will be superseded, consists of six horizontal low-speed Allis engines of 1,300 H.P. each and one Musgrave horizontal low-speed engine of 2,800 H.P. All drive British Thomson-Houston multipolar three-phase generators, which produce the energy at a pressure of 6,000 volts, with a frequency of 25 cycles per second. The total capacity of the station is over 7,000 KW., and there are four sub-stations equipped with transformers and converters for changing the current to 600 volts direct, which is the pressure used on the working conductors. All the plant, except the Musgrave unit, which belongs to a later time, was installed when the railway was opened in 1900, and it was the first example of high-tension three-phase distribution for railway traction in this country. An illustrated description of the station was given in THE TRAMWAY AND RAILWAY WORLD of July, 1900. One of the 6,000 KW. turbo-generators in the Chelsea station will be sufficient for the ordinary requirements of the Central London Railway.

low-tension feeders to the working conductors. The equipment of the sub-stations was carried out by the British Thomson-Houston Company.

The capacity of Stockwell power-station (which is now shut down) was about 4,000 KW. The line was the first underground electric railway in the world, the first section of it from the City to Stockwell having been opened in 1890. Though the original belt-driven plant was scrapped at an early date, the engines which were installed from time to time as extensions were made were an interesting and varied lot. They included two horizontal low-speed engines of 860 H.P. each, by Cole, Marchent and Morley, and the fly-wheels were discs with boiler-plate sides to obviate any risk of bursting. The other prime movers were four Willans and Robinson high-speed engines, two of 500 H.P. each and two of 210 H.P. each; a Ferranti engine of 550 H.P.; and a Lentz engine of 1,000 H.P. Practically all the dynamos were of E.C.C. make.

The Chelsea power-station, with its eight turbo-generators (Parsons-Westinghouse) of 6,000 KW. each, takes on the City and South London Railway load without difficulty. A new set of 15,000 KW. is now being installed, so that the Central London Railway, its extensions under construction, and extensions of other lines will be easily cared for. It is expected that the



Engine and Generator of Central London Railway, Installed in 1900.

In regard to the City and South London Railway, more change-over work had to be done. As is well known, this line, unlike the others, was worked with direct current transmission, and to reduce energy losses the three-wire system—and for the part of the line most remote from the power-station at Stockwell the five-wire system—was employed. Two sub-stations have been in use, but these, of course, were quite different in their equipment from those required where three-phase alternating-current transmission is employed. Three sub-stations equipped for the latter method have been provided, namely, at Stockwell (where the old generating station is), Elephant and Castle, and Old Street, while the Euston sub-station of the Charing Cross, Euston and Hampstead Railway has been enlarged so as to serve also the northern part of the City and South London line. The sub-station at the Elephant and Castle is also a joint one, the partner here being the Baker Street and Waterloo Railway, a former sub-station of the "Bakerloo" at St. George's Circus being superseded. The sub-stations have the usual equipment of transformers, converters, and high and low tension switchboards, through which 500-volt direct current is sent out by

concentration of power production at Chelsea will lead to great economy, as not only are works costs very low in such a large installation of turbine-driven plant, but many of the expenses of having separate stations at Shepherd's Bush and Stockwell will practically disappear.

Mr. P. V. McMahon, who was for so many years engineer and, later, manager of the City and South London Railway, is now superintendent of power for all the associated electric railways, and has the Chelsea station under his charge. His predecessor was Mr. J. W. Towle, who recently resigned to accept the appointment of chief engineer to the Barcelona Traction, Light and Power Company.

Canadian Railway to be Electrified.—Martin N. Todd, general manager of the Lake Erie and Northern Railway, Brantford, Ontario, and president of the Galt, Preston and Hespeler Railway, is reported to have confirmed the report that the Lake Erie and Northern Railway is to be electrified throughout the whole 52 miles from Galt to Port Dover. Mr. Todd expects cars to be running on the Galt-Brantford line by October, and to Port Dover by November. It is likely that hydro-electric power will be used, with sub-stations at Galt, Brantford, and Simcoe.

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SOME NOTES ON EARLY TRAMWAY HISTORY.

By T. B. Goodyer, A.I.E.E.
(*Tramways Manager, Croydon Corporation Tramways*).

When we consider the magnitude of the tramway industry in the United Kingdom to-day, it is difficult to realise that only fifty-five years have elapsed since the first line was opened in this country. The modern tramway was first employed in the United States where, owing to the inferior streets and roads in the cities, it was badly wanted; but even there the industry can scarcely be said to have had a beginning until 1852. It is true that the first American tramway—a section of the New York and Haarlem line—was laid in the main thoroughfare in the year 1832; but it proved unpopular, and was for a time suppressed. It was not until 1852 that tramways were revived in the same city by M. Loubât, a French engineer, who recommended and laid down a track, consisting of rolled wrought-iron rails laid upon wooden sleepers. The rails were constructed with a groove on the upper surface, to guide the wheels of the cars, which were made with flanges, like those of railway carriages and wagons. After this period tramways rapidly multiplied in New York, which owes much of its development to the tramways, the traffic upon which was of much more importance than that of the light wheeled vehicles used for ordinary circulation. The tramway afforded incalculable advantages, and it became an indispensable feature of locomotion in the principal cities of the United States. The long distances to be traversed, the generally bad condition of the streets and roads, and the comparative scarcity of other vehicles, formed a combination of circumstances which forced the tramway-car into general use for all classes.

Mr. Charles L. Light, an English engineer, devised and laid, in 1856-7, a short tramway in the streets of Boston, U.S.A., and lines were first laid in Philadelphia in 1855. Mr. George Francis Train, in his book, "My Life in Many States, and in Foreign Lands," says that in 1858 "Philadelphia had the most perfect system of street railway transportation in the world."

In the year mentioned there was not an inch of tramway or street railway in Great Britain, or anywhere outside New York and Philadelphia. The pioneer of tramways in Great Britain was the author of the work from which I have quoted above. His object in building street railways was:—

"That the workers of the world might save a few minutes from their days of pitiless toil, and so have leisure for enjoyment and self-improvement."

In 1858 Mr. Train wished to construct a street railway in Liverpool, but the authorities would not grant him the power to do so. Between 1858 and 1859 Mr. Train succeeded, however, in getting John Laird, the progressive and energetic shipbuilder, and head of Laird's Shipbuilding Works, who was chairman of the Birkenhead Commissioners, to interest himself in his proposal for the construction of street railways.

Tramway Cars at the Marble Arch, Bayswater, London, in 1861 (Reproduced from a Contemporary Lithograph).

With the consent of the authorities mentioned a line four miles in length, running out to Birkenhead Park, was laid. This was the first street railway in England, and from the start became popular. It may be of interest to record that when Mr. Train began building street railways he secured copies of the plans upon which the New York and the Philadelphia lines were laid, and these formed the basis upon which he constructed his English lines.

To the opening of the Birkenhead street railway, in August, 1860, within five months after the application for leave was made, Mr. Train invited most of the leading journalists and writers of London. At this gathering he suggested the organisation of a literary club, and this suggestion was the germ from which grew the Savage Club, of London. His speech at the opening of the first street railway of the "Old World" was reported in the *Liverpool Daily Post* and the *Birkenhead Advertiser* in August, 1860.

In 1861 Mr. Train obtained authority from the Metropolitan Board of Works to construct a "tramway" between the Marble Arch, Hyde Park, and

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Notting Hill Gate, a distance of two miles. The accompanying illustration shows some of the cars at the Marble Arch end of the line, one of these having seats on the upper deck with a canopy over them. Later, lines were constructed under his supervision from Victoria Station to Westminster Abbey and the Houses of Parliament, and from Westminster Bridge to Kennington Gate.

The drivers and conductors were dressed in the uniform of volunteers, to which great objection was taken by soldiers. Passengers crowded the cars at all hours, there being throughout the day a rush such as is seen in New York only in what are called "rush hours." Accidents were very frequent, and one boy was run over and killed. For this Mr. Train was arrested for manslaughter. It was proved, however, that the accident was entirely unavoidable, and he was at once released. Sir John Villiers Shelley, M.P., the chairman of the Metropolitan Board of Works, and the representative of the omnibus proprietors, led the fight against Mr. Train in the Bill for Parliamentary sanction for further construction. Mr. Train had six of the ablest lawyers in England (through Messrs. Baxter, Rose, and Norton, solicitors), to represent him. In consequence, however, of the strong opposition of the omnibus proprietors, aided by the sentiment in certain quarters, the Bill was defeated by only a few votes. He therefore abandoned further action in London.

Mr. Train subsequently went to the Potteries, in Staffordshire, and, after fighting down the prejudices, obtained the necessary consents and constructed a line in the crockery-making country, which was called "The Staffordshire (Potteries) Street Railway Company." Those tracks are there to-day, and form part of the main line of the Potteries Electric Traction Company.

The Birkenhead and London systems were not clothed with Parliamentary powers, and in consequence of the defective manner in which the rails were laid, proceedings were instituted to compel him to take up the lines. At Birkenhead, where the tracks had been laid with the approval of the Birkenhead Commissioners —and upon the condition of Mr. Train keeping the roadway in repair—the case was not so bad; and on an indictment for a nuisance being preferred, a verdict was given for the defendant, strong evidence being adduced in favour of the tramways. In London, however, where the local authorities repaired the road, the failure of tramways was more conspicuous, and, an indictment being preferred against Mr. Train, he was compelled to take up the rails, which were not again renewed. The failure in London, however, was set off by the successes obtained in Birkenhead and in Staffordshire.

Mr. George Francis Train undertook in 1861–62 to get Parliamentary authority to construct a tramway in Glasgow. His Bill was opposed by the city authorities, who intercepted him by inserting in a Bill then pending for the increase of the city's powers in other directions a clause giving the Council power to lay tramlines. The new power was not utilised, however, and in 1869–70 two syndicates, one or both being of American origin, again promoted Bills in Parliament for power to invade the Glasgow streets with a horse railway system. Again the authorities were aroused, and the result was a compromise all round. It was agreed that the city should keep the control of its streets, any part of which it was so unwilling to surrender, and that it should construct and own the tramlines, while the two syndicates were to unite in one company and work the lines on a lease. The first lines were opened in 1872, and the lease then made was to terminate in 1894. By its terms the company was required to pay to the Corporation—

(1) The annual interest charge on the full amount of the city's investment;
(2) A yearly sum for a sinking fund, large enough to clear the entire cost of the lines at the expiration of the lease;
(3) A renewal fund of 4 per cent. per annum on the cost of the lines, out of which they were to be kept in proper condition and restored to the city in perfect order and entirely as good as new in 1894; and
(4) A yearly rental of 750 dollars per street mile.

Such were the money conditions of the lease; and certainly the city's interests were well looked after. But, meanwhile, the interest of the public as passengers were equally well secured. First, it was provided that in no case should the charges exceed a penny per mile. This, it should be remembered, was at a time when fares were nowhere else less than 2d. Further, the Parliamentary Act described a number of important "runs"—those most likely to be used by labouring men and large masses of population, several of them considerably exceeding a mile—and specified that one penny should be the charge for these, and that morning and evening cars should be run for working men at half price, equal to one American cent.

The company which accepted these remarkable terms took advantage of a passing mania for investment in tramways, and sold the lease to a new company of local capitalists for a premium of about 750,000 dollars. This new company experienced hard times for two or three years, and not until 1875–76 did it begin to pay dividends.

In 1860 Mr. George Francis Train did not neglect Birmingham in the matter of street railways, for he was granted an experimental concession, which he failed to utilise, and in 1861 the Corporation itself obtained Parliamentary authority to build tramways. But nothing was done until after the General Tramways Act of 1870.

Mr. Train is entitled to the credit of laying the first street railways in England, having, as he expressed it, to overcome the most formidable of all enemies of progress—British prejudice! He afterwards constructed a line between Darlington and Stockton, and later, at Geneva, in Switzerland, and Copenhagen.

Mr. Train's achievements in England, in the pioneer work of building street railways, is a matter of recorded history. An account of his work, in this respect, will be found in a book by Dr. Albert Shaw, of the *Review of Reviews*, on "Municipal Government in Great Britain," as well as in other books that deal with the industrial life of the period.

In 1861, Mr. Ayrton and Sir Lawrence Palk brought forward a Bill dealing generally with the tramways question, but the Select Committee to which it was referred made no report. In 1862 the same committee was re-appointed, but the Bill was ultimately withdrawn. In 1865 two Bills were brought in—one for the metropolis and one for Liverpool—but both were thrown out on Standing Orders. The same results were obtained in the following year.

In November, 1865, a short length of tramway was laid in Castle Street, Liverpool, designed by Mr. Noble. Although this system, as then laid down, was finally abandoned—being removed after having been down four years—it formed a part of the original scheme of the Liverpool Tramways. The sample line did good service in allaying the apprehensions of the timid, and in silencing the objections of the fastidious.

In 1866 and 1867 application was made to Parliament for power to construct a system of tramways in Liverpool for which an Act, after some opposition in the House of Commons, was obtained in 1868. This was the first English system of tramways for passenger traffic that was authorised by Act of Parliament.

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The works were constructed by Messrs. Fisher and Parrish, of Philadelphia, under Mr. George Hopkins, as engineer-in-chief, and were commenced in May, 1869. The first, or south line, from the Exchange to Dingle, 3 miles 560 yards in length, was opened on November 1st, 1869, and further lines were opened at later dates.

In 1869 the Bill promoted by the North Metropolitan Tramways Company, for the construction of tramways on the Whitechapel, Mile End, and Bow Roads, received the sanction of Parliament. In 1869, also, Acts were passed for the construction of the Kennington, Brixton, and Clapham routes, from Westminster Bridge Road, by the Metropolitan Tramway Company; and the routes from Pimlico, by Vauxhall, to Greenwich, by the Pimlico, Peckham, and Greenwich Tramway Company. These two companies were, by their Acts, empowered to construct and work tramways in nearly all the main metropolitan thoroughfares on the south side of the Thames, and comprising 25 miles of streets. Towards the end of 1870 these companies were amalgamated and became the London Tramways Company. In later years this system was looked upon as being one of the best managed in London. In 1870 the London Street Tramways Company were authorised to construct tramways in the north of London.

In consequence of the success of this private legislation, a public measure became necessary, and accordingly, in 1870, a Bill was introduced into the House of Commons for the general regulation of tramways. It was referred to a Select Committee, and ultimately passed into law as "The Tramways Act, 1870." This Act laid down the general principles upon which tramways were to be constructed throughout the country. In the years 1870 and 1871 the North Metropolitan Tramways Company were authorised to construct further extensions, which made a total of 30½ miles of tramway authorised to that company.

In the beginning of 1873, 42 miles of tramways had been opened in the metropolis, and in 1876, the length was increased to 61 miles. In the year 1875, in the State of New York alone, there were no less than 87 street railway companies, having an aggregate length of 433 miles of tramway open for traffic. Under the stimulus afforded by the rapid spread and successful operation of the several systems at work, Acts were applied for and obtained, authorising the laying of tramways in many cities and towns in the provinces, and by June 30th, 1876, the total length of tramways in the United Kingdom was as follows:—

England and Wales	132 miles.
Scotland	41 ,,
Ireland	25 ,,
Total	198 ,,

Since the date mentioned, whilst there has been, as the following figures extracted from the last-issued Board of Trade Return show, a considerable development of tramways, in many quarters it is considered that a greater expansion ought to have taken place.

England and Wales	2,213 miles
Scotland	317 ,,
Ireland	173 ,,
Total...	2,703 ,,

Of the 279 undertakings, 171 belong to Local Authorities, and 108 to companies or other parties.

The total capital expenditure has amounted to £80,977,838. For the year ended, in the case of companies, December 31, 1913, and in respect of municipal systems, March 31, 1914,

The total traffic receipts were ...	£15,787,877
The number of miles run	354,379,672
The passengers carried	3,426,473,192
Number of electric cars	13,196
,, non-electric cars	462
,, horse cars	956
,, locomotive engines ...	29

It is interesting to recall that there are still amongst us to-day in the tramway service some who were engaged in its early work, and in this connection I may refer to Messrs. J. Barber Glenn, Hammond (now of the M.E.T.), Sir George White (Bristol), Moreton (Plymouth), Mallins (Liverpool), Nance (Belfast), and Challenger (Bristol).

PETROL-ELECTRIC CARS IN IRELAND.

The first of the two petrol-electric cars ordered by the Dublin and Blessington Steam Tramways Company was put into operation on Sunday, August 22. In announcing this fact to the shareholders at the fifty-third ordinary meeting on August 24, Mr. T. H. Richardson, the chairman, stated that from the short experience they had had of the first car the directors and manager were convinced that they were at the beginning of a new era for the undertaking. They had looked forward to having them in operation by May 1 of this year, and the car builders were ready at that time. The equipments were actually delivered, but the petrol engines were commandeered by the Government for war purposes when finished. This happened with several consecutive sets. The directors had to thank the Dublin Members of Parliament for the assistance they gave a deputation to the Admiralty, which succeeded in getting permission for the engines to be completed for the cars.

The new cars were built by Hurst, Nelson and Company, Limited, of Motherwell, to the design of Mr. J. P. Tierney, C.E., the managing director of the tramways, and they will each accommodate 75 passengers, besides hauling one of the existing steam cars as a trailer. With a view to running over the system of the Dublin United Tramways Company, the petrol-electric cars will be so fitted that the two motors can obtain current from the trolley wire.

"SAFETY-FIRST" WARNINGS TO EMPLOYEES.

Some useful safety-first suggestions come from Mr. A. D. Garriott, foreman of a car depot of the Louisville, Kentucky, Railway Company. Mr. Garriott says:—

If the principle of safety was as readily followed as our rules and regulations are sometimes neglected, we would all soon be perfect, and avoidable accidents would be a thing of the past. But it is much easier for us to see the carelessness of the public or of someone else than it is to hold ourselves from violating some of the principles of safety. How often do we see men who advocate safety first, and who are really interested in the safety movement, do things on a sudden impulse that are a bad example to anyone who may see them. We see a car approach a car depot or some place that is not a regular stop, the motorman catching the front of the car while it is in motion. We see employees run after cars or climb over the rear dash or ride the coupling to the next stop. Again we see motormen stand on the lifeguard and reach through the front vestibule and move the car. We see car depot employees stand in passageways where cars might split switches and cause serious accidents. We could also show where track men and men in all departments violate the principle of safety. Now we cannot say that these things are done deliberately; they are done simply because we do not think, or to save a few steps or a little time. I think if every man would make a resolution to set an example of safety, much good could be accomplished. Don't look for some defect in equipment or something someone else should have done, but ask yourself the question—"What am I doing to prevent accidents, and am I practising safety first?"

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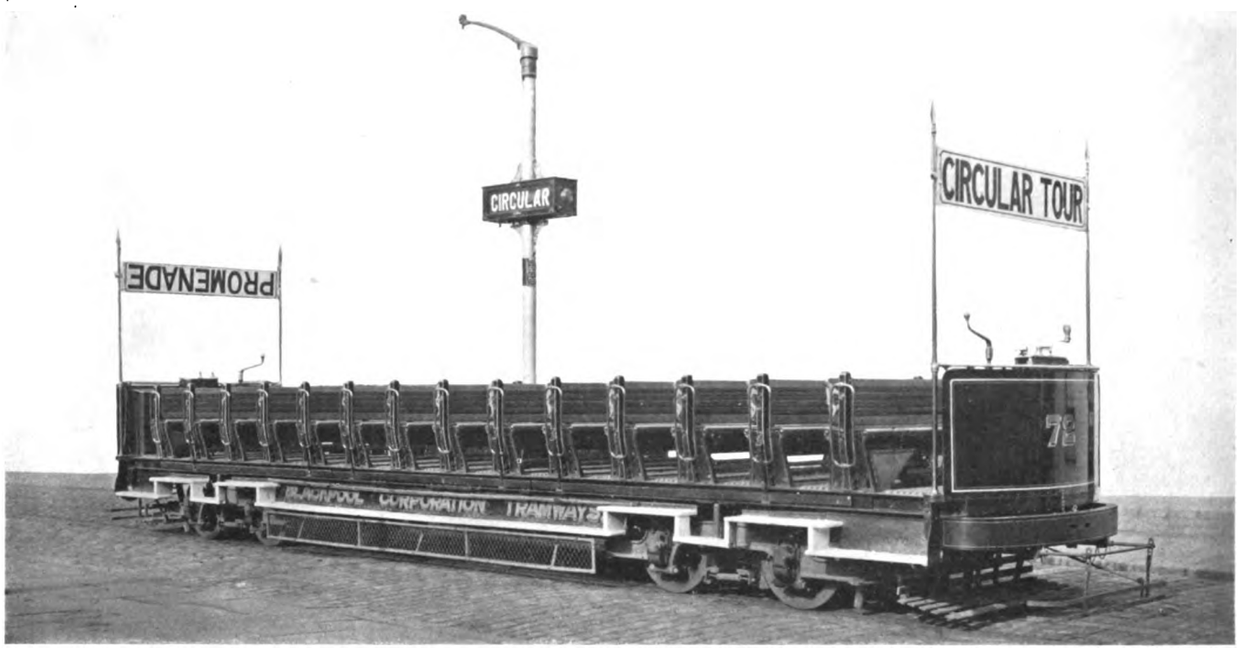
OPEN-SIDE CAR FOR RELIEVING TRAFFIC RUSHES.

On the suggestion of Mr. W. T. Robson, who was recently appointed general manager of Southampton Corporation Tramways, an interesting experiment is to be tried with the sanction of the Tramways Committee and the Town Council. If it proves successful it will indicate to tramway authorities a new and economical method of meeting periods of traffic rushes on holidays and special occasions. It may even exert a further effect in the way of bringing the toast-rack type of car into use either as trailers or as motor cars during the rush hours of the ordinary weekday traffic.

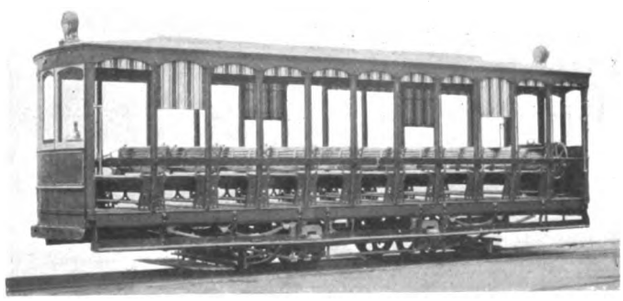
As Mr. Robson observed in his report to the Tramways Committee of Southampton, the open-side car is a fine-weather car, but so to a great extent is the double-deck car when unprovided with a top cover. The popularity of the open-air ride in fine weather is attested by the patronage bestowed upon the coverless double-deck trail cars run on the London County Council Tramways. These are now the only vehicles on the County Council's lines that have an uncovered top deck, and in spring, summer, and autumn the top deck is usually the first to fill up, despite the fact that the windows of the saloon of the trail cars are adjustable and are frequently placed half way down.

The economical aspect of the scheme is twofold, for the open-side car will cost less to construct and less to run. By Mr. Robson's plan of providing the car the outlay will be so low that many other tramway managers may be tempted to put it into operation and work out the traffic possibilities for themselves without waiting the result of the Southampton experiment. Amongst the stock of cars that Mr. Robson has taken over are several in a defective condition, and so old are the bodies that he does not consider them to be worth rebuilding in their present form. He proposes instead to adapt one of them to the toast-rack design at an approximate cost of £50. Mr. Robson suggested that a few cars of this type should be provided in place of the extra cars now kept in reserve for the fine-weather traffic associated with bank holidays and other special occasions.



Toast-Rack Car of Blackpool Corporation Tramways.

Blackpool was mentioned by Mr. Robson as an instance of highly profitable running of open-side cars. It may be added that the chief summer playground of the Lancashire and other well-to-do artisans provides two such instances. First there is the circular tour of the Blackpool Corporation Tramways. Few visitors leave Blackpool without having made that trip in the open-side bogie-truck cars, of which an illustration is given on this page. Part of the route lies along the sea front promenade, and the circular tour is responsible for a considerable portion of the heavy summer earnings of the Corporation Tramways undertaking. The other car shown on this page has a canopy roof and blinds, and it is run by the Blackpool and St. Anne's Tramways Company. It was constructed by the United Electric Carriage Company, of Preston, the body being mounted on a single truck. Southport, we believe, is another place where profitable use is made of a similar kind of car.



Another Type on Blackpool and Fleetwood Tramroad.

Considerable discussion took place with the Board of Trade before sanction was obtained to run the Blackpool cars, and in order to prevent the risk of accidents to passengers a barrier has to be maintained along one side of the car at the height of a passenger's elbow when a person is seated.

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Cars similar to that of the Blackpool Tramways Company have long been in general use in the United States, where they are termed open-bench cars. Twenty of them on bogie trucks were brought into use at the opening of the summer season on the New Jersey Tramways. They were constructed in the company's shops, and the object of adding to this type of stock was to provide a large seating capacity car for the summer season at a reasonable cost. The experience of the company therefore provides a justification for the use which it is intended to make of open-side cars at Southampton.

Convertible Car, Wellington (N.Z.) Tramways.

Great popularity, especially with women passengers, had been gained by similar cars on the New Jersey Company's lines, and the latest additions are running on a section which connects two railway terminals and passes through East Orange, Orange, and West Orange. A considerable amount of short haul business is carried on that line, and from that point of view it is important to note that the company do not find that the use of the cars is conducive to accidents, while such mishaps as do occur are of a trivial nature. By providing ample seating capacity and keeping passengers off the running board as much as possible the results are very satisfactory. It will be seen from the illustration that the car has no side barrier, but that two perpendicular hand rails are attached to each side post.

A double step provides easy access from the street, and the lower step can be folded up inside the line of the upper one to give necessary clearance. The front step is 15 in. from the top of the rail, the next is $13\frac{1}{8}$ in., while the final step formed by the car floor is $8\frac{3}{8}$ in. The floor is thus slightly over 3 ft. above the rail. Wheel guards without fenders are used. The 15 rows of seats, each accommodating six passengers, are non-reversible, and are 8 ft. long between side posts. They are made of $1\frac{5}{16}$ in. maple strips with $\frac{1}{8}$ in. space between. The seats are 15 in. deep, and 17 in. spaces are provided between adjacent seats. The back is curved to give greater comfort in riding. Including the small seat on the platform the car seats 96 passengers.

In designing the car for minimum cost and reasonable lightness standard structural shapes were used throughout and the underframe was laid out as a truss to give the necessary resistance to horizontal twisting and end shocks, while vertical stresses were provided against through the use of deep channels as side sills. Each car is equipped with four Westinghouse 101-B2 motors and Westinghouse HL control. The purpose in using the latter was to get the contactors out of the sight of the passengers who are apt to be frightened by the arcs in the ordinary form of controller. There are about 5,300 lbs. of steel used in the car, and the weights of the different parts and of the complete car equipped but without load are as follows :—

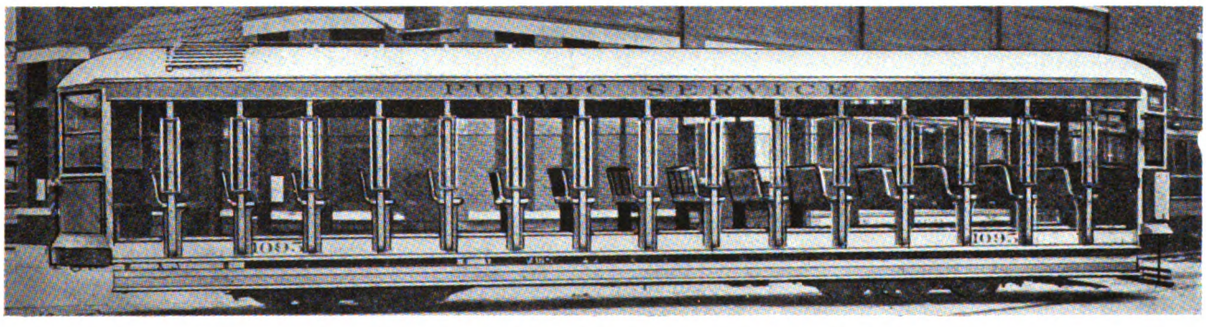
Body	... 13,200 lb.
Control	... 1,800 lb.
Air brakes	... 1,220 lb.
Hand brakes	... 200 lb.
Wheel guard	... 200 lb.
Motors	... 10,580 lb.
Trucks	... 13,000 lb.
Total	... 40,200 lb.

The weight works out at about 420 lb. per seated passenger.

On the Wellington (New Zealand) Corporation Tramways an ingenious type of car was brought into use in 1907, both for single and double deck cars. As the appended illustration indicates, the cars can be used as either closed or open-side vehicles, according to the weather or the season.

"SKIP-STOPS" ALLOWED IN ST. LOUIS.

The Missouri Public Service Commission has made an order authorising the United Railways of St. Louis to abolish 102 stops for three months. Sixty-two of the stops to be eliminated in the test are on the Broadway line. The remainder are on the Olive-University, Olive-Delmar, and Olive-Maryland lines. The opinion is that the United Railways in asking that 770 stops on various lines be eliminated did not submit sufficient proof that the changes sought would not inconvenience the public or result in greater safety to passengers and pedestrians. The experiment eliminating the 102 stops began on September 1. The order states that if at the expiration of the test period it is determined that better service can be rendered to the majority of passengers on those lines, the United Railways will be permitted to petition the proper municipal authorities of St. Louis for the necessary modification of regulations to eliminate all useless stops.



A Popular Summer Car on the New Jersey Tramways.

Manchester-Bury Railway Electrification.—Although trial runs have been satisfactorily made on the Lancashire and Yorkshire Company's electric railway between Victoria Station, Manchester, and Bury, the service is not expected to be in operation before October or November.

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THE
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L.C.C. Tramways' Position.

A good deal of comment has appeared in the Press in regard to the deficit of £33,000 on the working of the London County Council Tramways during the past financial year. In dealing with the subject, we ourselves have advocated an increase in the fares charged to workmen, which at present result in a loss of about £80,000 per annum, and also a revision of the ordinary return fares, which are very low. Our contemporary, *Motor Traction*, whose views as a rule are sane and reasonable, contrasts in our favour what has been said in these pages with the treatment of the subject by a London evening newspaper. But the latter journal was quite correct in pointing out the special burdens imposed on the tramways from which motor omnibuses are free. The point is perfectly relevant, and it has been repeatedly made in our pages. *Motor Traction* also says:—"Though our own interests are naturally bound up with the motor omnibus, we want to avoid taking any biassed view on this perennial and vexed subject, simply because the best form of transport is bound in the long run to win, whatever the protagonists of the trams may say." In regard to that, the interests of this journal are not bound up with any particular form of street traction, and consequently there is no reason why biassed views should be taken or encouraged in these pages. We believe there is ample scope in varying circumstances both for the tramcar and the motor omnibus. It has always been our aim, as set out in the first issue of this journal, to encourage all new methods that give promise of usefulness. The progress of motor traction thus received early attention in these pages, and for the past ten years a special motor traffic section has been included in each issue. But we are not of opinion that "the best form of transport is bound in the long run to win," in the sense that some one form will become universal. On the contrary, all the indications are that both the electric tramway and the automobile omnibus (both petrol and electric) will each hold a field of its own, but each must do so upon its true merits. Neither system, if the public interests are to be served, must be given fictitious advantages. Each must have a fair field, and each must succeed because of the value and economy of its services. Now at present there are special burdens on the London County Council Tramways from which the omnibuses are free; they amount for a year to approximately the following: Rates on permanent way, £88,000; saving to local ratepayers by the tramways maintaining the paving between the rails and tracks, £134,000; annual charge on cost of street widenings, £36,000; total, £258,000. Omnibus services would not appear particularly flourishing if they had to bear an analogous burden in proportion to the mileage run. If they had to carry workmen at low fares their case would be still worse. In fact, there would be a danger of their business being stopped. Hence they bear only a small burden now in the shape of petrol tax, and though a charge for road maintenance is likely to become general, it may with some confidence be predicted that it will not be excessively high. Indeed, it is wholly undesirable from every point of view that motor traffic development should be hampered by undue taxation.

Ostrich Policy at Scotland Yard.

The violin performance attributed to an historic personage while Rome was in flames has been outdone at Scotland Yard. The small portion of the Empire comprised by the British Isles is spending two and a half million pounds

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per day to prevent the Germans crossing the Channel and placing this country under tribute. Yet the Metropolitan Police are continuing their absurd policy of prosecuting municipal and company tramway managers for placing unlicensed motormen and conductors upon cars transporting workers engaged in the manufacture of munitions with which to repel the German onslaught. Several prosecutions have been carried out, and it has been shown that the police are not only deserving of censure for indulging in what savours of petty tyranny, but are seemingly guilty of neglect of duty. Evidence has gone to prove that in several cases the men had sent in applications for licences some weeks before the dates to which the summonses referred. This failure to deal promptly with the applications, combined with the vexatious action of the police and their refusal to license female conductors, constitute an indictment that ought to be brought before the Government by a deputation representing the tramway managers and their respective municipalities and companies. The antics of Scotland Yard no doubt are viewed with amazement by provincial heads of police, and there is good reason why such a feeling should animate the Government if the facts are properly placed before them, especially in regard to the prosecution for a second time of the manager and several conductors of the Dartford Tramways Company. That fines were imposed is not a matter for surprise when we read of the babbling attributed to one magistrate. This oracle declared that he knows many men over 45 who would make conductors, that he personally could run a tramcar, and do it well, although he was over 75, and he could get men who could do it. Regarded from the point of view of the Government, the obstruction by the police is a serious matter. The War Office are calling for men for the forces in every direction, and when the Dartford Company, unable to find men above military age, employ lads, the police have the impertinence to assert that men could be obtained if better wages were paid. Scotland Yard stands condemned by the utterances of its own mouthpieces. For more than half a year the London motor omnibus companies have been advertising at their garages for conductors, and on August 30 an advertisement appeared in the newspapers for "young men unfit for military duty" to be trained as drivers and conductors of motor omnibuses in London. This is not the first time that such an announcement has been made, and as the London omnibus service is the best paid traction work in the whole country, it renders the attitude of the police self-condemnatory. If any argument other than the lack of men is necessary to induce the Home Secretary to assert his authority over Scotland Yard, it is to be found in the statement made at the police court by the assistant manager of the munition works served by the Dartford Tramways. It was to the effect that if any of the cars were withdrawn from the service their absence would be a serious blow to Messrs. Vickers, notwithstanding that they are running omnibuses at a great loss in order to take their men to and from the works.

Skip-Stops in the States.

Several of the street railway traffic reports recently published in America deal with the question of increasing the schedule speed. This question is, or ought to be, always before the mind of the British tramway manager; and at the present time it appears in an aggravated form. The dearth of labour has made it difficult to maintain the normal number of cars on the road, although the volume of traffic available may not have diminished. If it were possible to raise the schedule speed all round, the frequency of the service could be approximated to the former figure. The most obvious plan is to raise the maximum speed; and no doubt that could be done on many British tramway systems by closing the managerial eye upon Board of Trade limits. But it is noteworthy that in the States attention is not directed to this point—probably because there is no margin for a rise in American maximum speeds. What is aimed at is a reduction in the waste time on journeys. Within congested districts much can be done by the proper control of other vehicular traffic; unfortunately that control is not left to the tramway undertakings. The more promising direction for improvement lies in reducing the delays in stopping to pick up or set down passengers. This can be done either by reducing the number of stops or by reducing the time of

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passenger interchange. In order to achieve the former purpose American street railways have adopted what is called the "skip-stop" plan. This is intermediate between the all-stop and the non-stop methods. Strictly speaking, the "non-stop" trains on our tube railways are examples of "skip-stops." American managers retain the phrase "non-stop" for express cars, and the non-stop method has been adopted in Detroit, where certain cars run through factory loading districts at particular times of the day in order to take care of the general traffic at points beyond the factories. In Detroit also the stops on four routes are to be reduced from twelve to eight per mile, giving an estimated increase of 10 per cent. in the schedule of speed, notwithstanding the addition of trailers. In Cleveland trailers were put on and the stops were reduced from fifteen to nine per mile, with an increase of 40 per cent. in the number of passengers carried but without exhausting the capacity of the route. It is doubtful whether a similar improvement is possible on British tramway systems, with their fixed stopping-places, optional and otherwise, and with the official ban upon trailers. Nevertheless the results of the American experiments are well worthy of attention. Some attempt has also been made to save time by accelerating the movements of passengers at stopping-places. We see no reason why tramways should not follow the example of tube railways, and continually exhort the passengers to achieve something better than a snail velocity. Alterations of car design are also involved in this side of the problem, but these will certainly have to be held over until after the war.

RAIL WEAR ON CHICAGO TRAMWAYS.

Some interesting data on rail wear in Chicago are presented in the sixth annual report of the Chicago Traction Board of Supervising Engineers. The report says that it is the general impression that vehicle traffic causes but very slight wear on a railway track when it is properly built, but recent observations made on a section of unused track laid with a standard concrete base seems to contradict this conclusion. This section of track had never been used by cars since it was laid owing to the objections of abutting property owners, so that all of the wear upon it had come from vehicles. Careful measurements made with Vernier instruments after this track had been in the street for 40 months showed that approximately 1/32 in. reduction had occurred in the rail head, measured on the centre line of the tread. This represents 5 per cent. of the wearing life of the original section of the rail. As the tread was perceptibly coned, the maximum wear was greater than that shown by these measurements. These results are corroborated by the fact that the lip of old girder rails had been worn down and bent over elsewhere in the city by vehicular traffic, and in some cases the tread of standard 129 lb. rails has been considerably enlarged by the wear and tear of wagon wheels, thus materially reducing the wearing width of the rail tread.

To determine the extent to which vehicular traffic is responsible for the wear of rails, a large number of observations were made at different points of the system. The results are thoroughly consistent, and are shown in a diagram, in which the relative proportions of wear from cars and vehicles are indicated for varying average headway of cars along the street. The diagram shows that even on a line with a great deal of car traffic, such as 40 cars per hour for a 24-hour day, vehicle wear may amount to as much as half of the total wear on the rail head, thus reducing the life of the rail by a corresponding amount. Other measurements, taken on short sections of track laid along the edge of Lincoln Park, where the rail was not subject to any vehicle wear, but carried a large car traffic, showed a wear no greater than that on Cottage Grove Avenue and on Madison Street, with only half the car traffic but with heavy team traffic. Elsewhere in the chapter on track the report says that study is being given to the development of an improved rail fastening, so that the full advantages of steel ties may be realised, and also to the development of reinforced concrete ties with a suitable fastening. This is being done because of the rapid deterioration of wood ties, due to the seepage of moisture through the pavements, especially where frequent sprinkling of the track is practised.

As a result of rolling the subgrade and the use of a concrete foundation with tie plates, the settlement of the track structure has been reduced to an inconsiderable amount. However, the use of the usual sand cushion under granite block paving has proved unsatisfactory, particularly for pavement adjacent to the rails. Consequently, paving blocks adjacent to the rails are now being set in cement mortar, applied either dry or wet. This simple expedient has practically done away with the settling of pavement along the rails.

The report also refers to the method of making track repairs by electric welding. Current is taken from the trolley wire through a resistance, and tool, or alloy steel, is deposited at defective points by means of the electric arc. Up to this time the attempt to repair defects in solid manganese special work has met with only indifferent success, presumably owing to lack of definite knowledge as to the metallurgical process involved. But on rails the plan has been successful. Cupped joints have been built up level, hammered special work has been resurfaced, treads have been built up so as to renew flange-bearing special work, broken intersections have been saved until the renewal is made of the whole layout, loose sections have been welded in place, and numerous other applications of extra metal have been made to lengthen the life of the track structure.

IMPORTS OF AMERICAN MOTOR CARS.—The Board of Trade returns show that the number of complete motor cars imported from the United States in 1910 was 1,101; 1911, 3,734; 1912, 4,377; 1913, 3,619; 1914, 6,225. The value of the cars was: 1910, £215,297; 1911, £592,264; 1912, £762,907; 1913, £744,392; 1914, £1,311,932.

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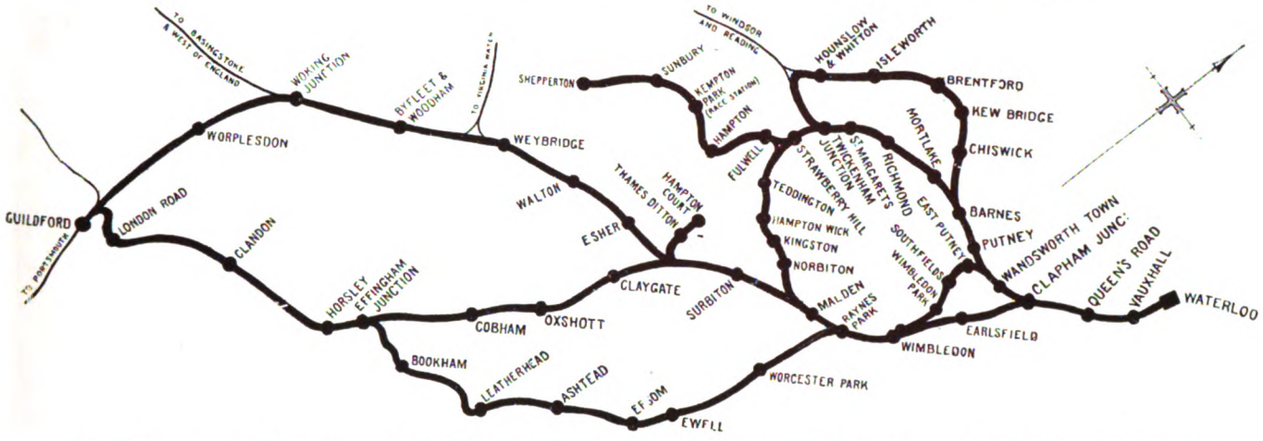
LONDON & SOUTH WESTERN RAILWAY.

ELECTRIFICATION OF SUBURBAN LINES.—NEW TRAINS ON WATERLOO AND WIMBLEDON LOOP.

The electrification of the Suburban Lines of the London and South Western Railway has now been in progress for some time, and current will be switched on to the conductor rail on the Waterloo and Wimbledon (via East Putney) line in a few days. The "Kingston roundabout" section will be ready shortly after, and the remaining sections will be completed with as little delay as possible. The accompanying outline map shows the lines that are being electrified.



Outline Map showing Suburban Lines of the London and South Western Railway now being Electrically Equipped.

The first section of the scheme involves the equipment of about 150 single line miles of track for electric traction and includes the electrification of the Waterloo and Wimbledon line, *via* East Putney, the "Kingston roundabout" line, *via* Wimbledon and Richmond, the loop line from Barnes to Twickenham, *via* Hounslow, the Thames Valley Line to Shepperton, and also the lines between Malden and Hampton Court and Hampton Court Junction and Claygate. Direct current will be supplied to the trains, at a pressure of 600 volts, by a conductor rail, the track rails being the return. The company has built a power house at Durnsford Road, Wimbledon, close to the railway. The constructional work is completed and a considerable portion of the machinery is fixed. The equipment includes 16 Babcock and Wilcox boilers, each capable of evaporating over 20,000 lb. of water per hour; these supply steam at a pressure of 200 lb. per sq. in. and a superheat of 200° Fahr. to five turbines coupled to 5,000 KW. three-phase alternators, supplied by Dick, Kerr and Company, Limited. Three auxiliary turbines, coupled to 400 KW. direct-current generators, are also provided to supply power for lighting the building and for driving the auxiliary machinery in the power house. A 40 tons overhead crane is provided in the turbine house. The condensers are placed in a basement beneath the turbine house and will be supplied with cooling water from the River Wandle, which is adjacent to the site. This water will be returned to the river over a series of weirs, which have been constructed for the purpose of cooling the water before it is discharged into the river. Three cooling towers are also provided for use at times when the river water is insufficient.

Adjacent to the power house, repair and inspection shops for the electric trains are nearing completion.

The current generated at the power house is distributed to the sub-stations at a pressure of 11,000 volts by paper-insulated, lead-sheathed, three-core cables. In the section now in hand there are 76¼ miles of this cable, most of which has already been run out and fixed in position.

Three-Car Electric Train of London and South Western Railway.

For the purposes of lighting the sub-stations and passenger stations on the electrified area and of supplying power in connection with the track-circuit signalling arrangements, a separate paper-insulated, lead-covered cable has been run. Alternating-current, at a pressure of 3,300 volts, is supplied through this cable to static transformers placed in small brick chambers built at intervals along the route, current being transformed down to 220 volts. Sub-stations have been built at the following places:—Waterloo, Clapham Junction, Raynes Park, Kingston, Twickenham, Barnes, Isleworth, Sunbury, and Hampton Court Junction. These

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buildings are all complete, and are being equipped with static transformers and rotary converters, together with the necessary switch gear for converting the three-phase alternating current into direct current at 600 volts, at which pressure it will be supplied to the conductor rails.

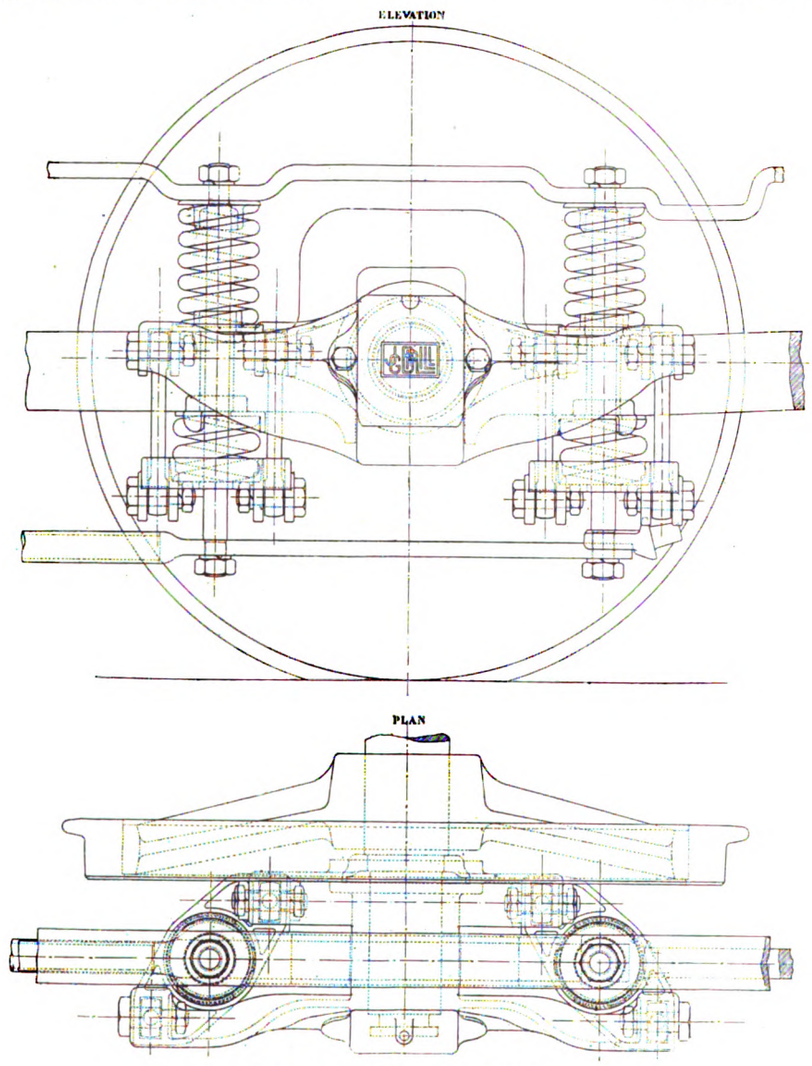
The conductor rails, which are of the usual flat bottomed section, weigh 100 lb. per yard and are composed of special steel, the electrical receptivity of which is about $6\frac{3}{4}$ times that of high-conductivity commercial copper of the same cross sectional area. These rails are laid on porcelain insulators, with their contact surface at a height of three inches above the track rail and with their centres 16 inches from the gauge side of the track rail.

Every joint in the running rails is bonded with two flat copper wire bonds, which are protected by special fish plates. Negative cross bonds of ·15 sq. in. sectional area are used to connect the track rails. This ensures the equal distribution of the return current over all tracks.

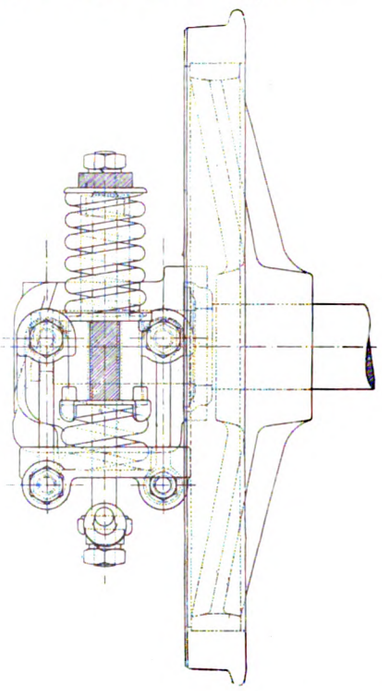
The current is collected from the conductor rail by cast steel shoes. The trains will be arranged in units of three coaches, which will be permanently coupled together, and it is intended to work these units as three or six coach trains according to traffic requirements. Each unit is fitted with four Westinghouse motors geared to 43 in. driving wheels. These motors are mounted in pairs on the bogie beneath the driving compartment at each end of a unit. The coaches are heated with electric radiators.

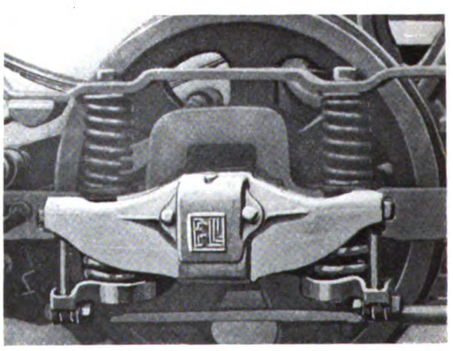
BRILL SWING-LINK 21-E TRUCK.

The Brill swing-link truck has been designed to counteract body oscillations on single truck cars. The heavy shocks and blows at the flange and rail head due to side thrusts and endwise swinging of the body not only tend to stress and distort the car-body structure, but subject the passengers to extreme buffeting and discomfort. The Brill swing-link truck intercepts the rigid thrust of the car-body and its load, modifying these side shocks and thus introducing greater flexibility between the truck frame and car-body. In effect, this swing-link truck brings to the short car all the advantages of the cushioned bolster of the bogie car.



Swing Link 21-E Brill Truck.





The Swing Link.

Whilst the axles on the truck are always parallel, the swinging movement of the journal box links permits a slight lateral movement of the axles across the truck, allowing the car to curve more easily. The swing-link truck thus permits the car to be worked round curves at greater speeds without the present shocks or lurching of the car-body. The car-body structure here benefits and the cushioned movement is vastly more comfortable for the passengers. Another result is to reduce noise on curves. This flexible suspension furthermore means a more silent operation on straight track. Again, the easement permitted on curves renders a slightly longer wheel-base feasible, bringing additional stability to the car longitudinally. The cushioning of the shock at the wheel flange and rail head minimises

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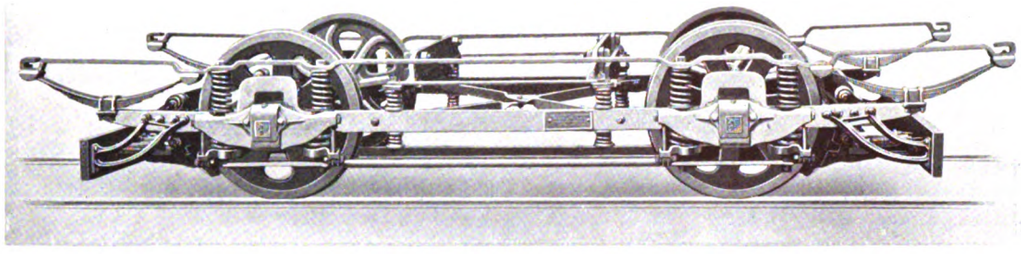
the effect of the blow, thus reducing wear at these points. The elimination of the heavy blows transmitted should lengthen the life of the axles.

Necessarily a swinging movement of the truck frame relative to the axles requires a swinging motor suspension, and this is attained in a very simple and efficient manner, as will be noted from the illustrations. Particular attention has been given to obtaining interchangeability with existing Brill 21-E trucks, thus rendering existing trucks adaptable to this swing-link suspension. It is, therefore, possible for a Brill standard 21-E truck at once to accommodate the swing-link journal box and auxiliary motor suspensions, thus converting it into the latest swing-link pattern. The existing journal bearings, checkplates, oilers, fibres and box springs can be utilised in connection with the new swing-link journal boxes. This has been carefully considered to eliminate the multiplicity of new parts. The existing motor suspensions are utilised, merely requiring bending to give a slight set and bolting the auxiliary motor suspensions and links thereto.

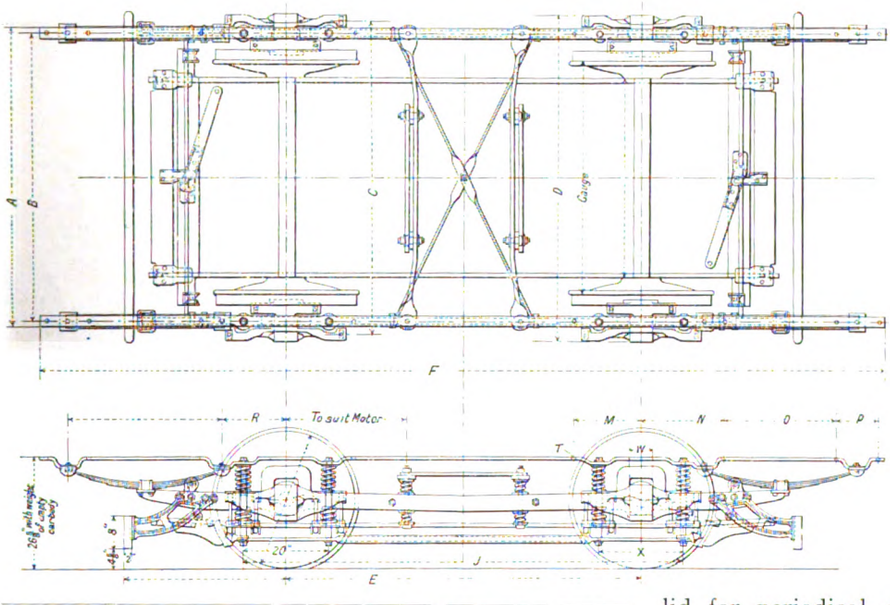
The swing-link journal box has ears cast integrally, which form the supports for the links. The holes at each end of the links are case-hardened, and moreover, the bolts that pass through the holes are case-hardened. These bolts are bolted tightly to the pockets or cast seats in the wings of the journal box so that all wear comes upon the case-hardened bolt and the case-hardened hole in the link. This ensures long life for these working parts.



Swing Link 21-E Brill Truck.

The wide centres of the journal box springs, longitudinally of the trucks, will be noticed; this gives a long lower spring base—as a matter of fact, over 7 in. more than the standard 21-E truck with a short wing box. This increased spring base is largely responsible for the steadiness of the car at high speeds. The journal box springs are placed in a direct vertical line with the car-body springs. This alignment of suspension plays a very important part in the riding comfort of this truck. This vertical alignment of suspension also relieves the side frame of the usual stresses at the yokes.

This swing-link journal box is provided with the Brill patented low-lid opening. This permits easy access to the oiler, and, in fact, the oiler can be inspected or entirely removed in a few seconds. Another refinement is the provision of a $\frac{3}{4}$ in. hole in the top of the lid for periodical or temporary oiling. This hole is fitted with a screw plug. These swing-link journal boxes can be used either right or left-hand.



		ft. in.	Metre. ft. in.	ft. in.	ft. in.	ft. in.
	Gauge	3 0	3 3⅜	3 6	4 0	4 8½
A	Width over Top Chords	5 0¾	5 1⅜	5 4¾	5 10⅞	6 0
B	Centres of Top Chords	4 10	4 10⅜	5 2	5 8¼	5 9¼
C	Centres of Outside Links	5 4	5 4⅜	5 8	6 2¼	6 3¼
D	Width over Journal Boxes	5 7½	5 8¼	5 11½	6 5½	6 6½
L	Length of Axle	5 5⅝	5 6¼	5 9⅝	6 3⅜	6 4⅞

		ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
E	Wheel Base	6 0	6 6	7 0	7 6	8 0	8 6	9 0
F	Total Length	15 7	16 1	16 7	17 1	17 7	18 1	18 7
G	Spring Base, Upper	14 6	15 0	15 6	16 0	16 6	17 0	17 6
J	Spring Base, Lower	7 8	8 2	8 8	9 2	9 8	10 2	10 8
M	Location of Body Bolt Hole	16	16	16	16	16	16	16
N	" " "	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜	19⅜
P	" " "	10	10	10	10	10	10	10
O	" " "	26⅜	26⅜	26⅜	26⅜	26⅜	26⅜	26⅜
R	Location of Body End Spring Cap	15	15	15	15	15	15	15
S	Centres of Semi-elliptic Spring	36	36	36	36	36	36	36

Plan, Elevation, and Standard Dimensions of Brill No. S-L 21-E Truck.

"Underground" Booklets on London.—The Underground Railways and London General Omnibus Companies have in course of preparation a series of illustrated booklets dealing with notable features of London and its environs. Some 12 subjects will be touched upon, among them the Tower, Zoological Gardens, City Churches, Hyde Park, the Markets, and St. Albans. Each booklet will consist of 16 pages, with 12 or more original photographs, and sketch maps of the places described. In every way they are excellent examples of artistic printing. The first two booklets, the Tower and the Zoological Gardens, are now ready, and may be had free of charge on application being made to the stationmasters at the Underground stations, or to the advertising manager, Electric Railway House, Broadway, Westminster, S.W. It is hoped to issue shortly the booklet describing a motor-'bus tour through the centre of London, giving in tabulated form all the features of interest passed en route, and having no fewer than 75 illustrations.

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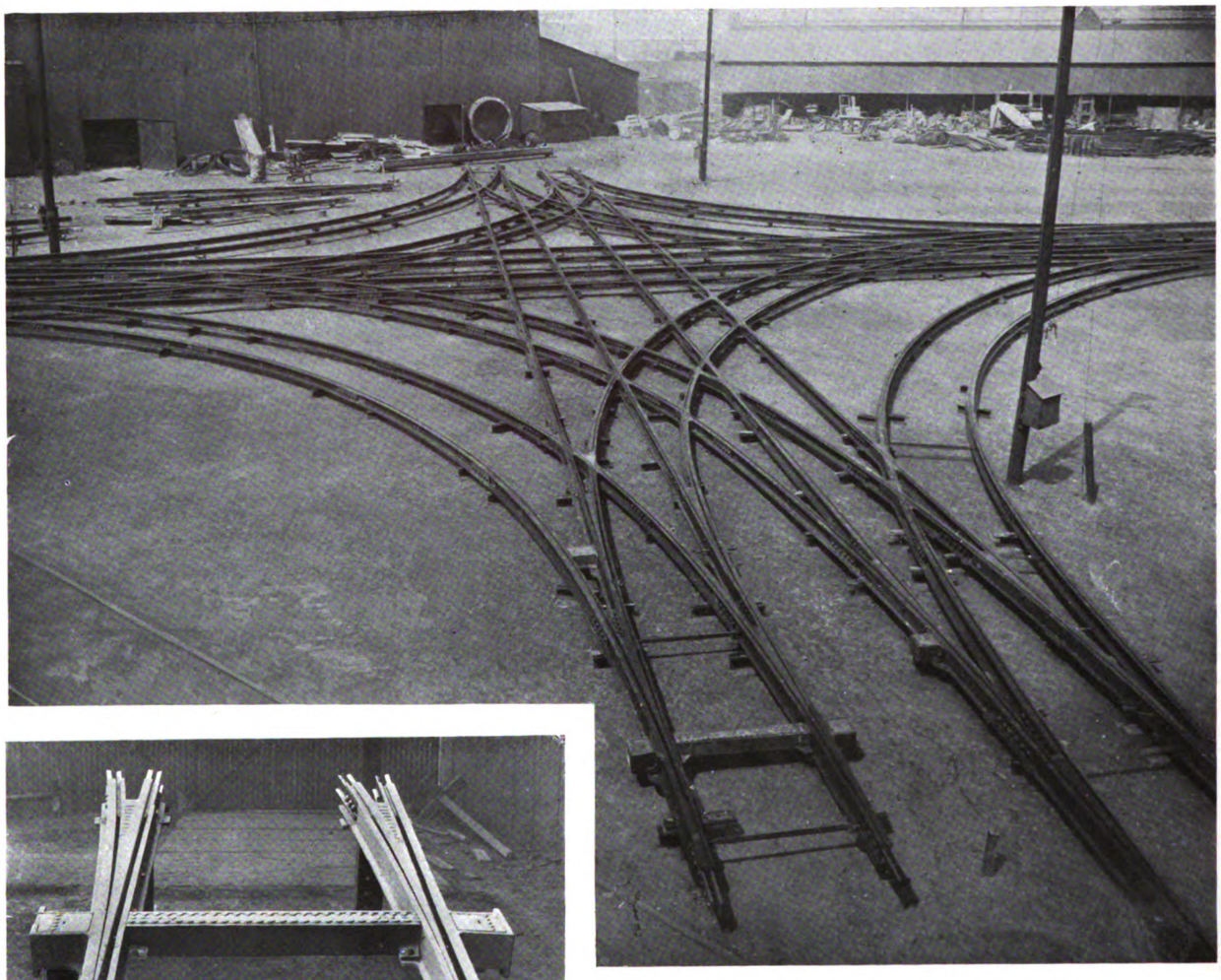
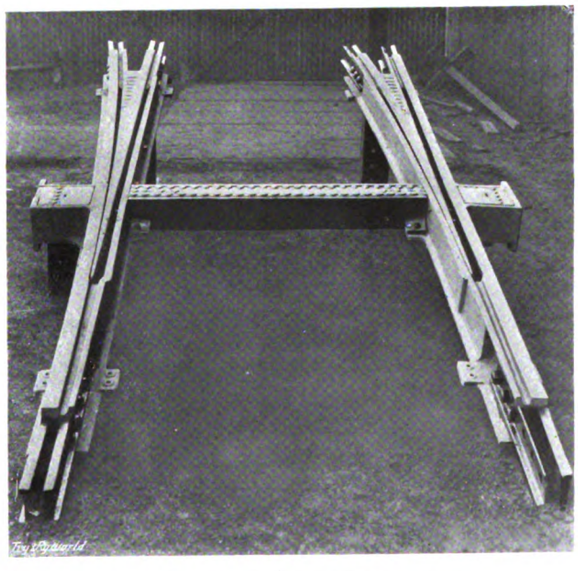
EXTENSIVE LAY-OUT FOR AN IMPORTANT COLONIAL TRAMWAY.

The accompanying illustrations convey a good idea of a very important lay-out manufactured by Edgar Allen and Company, Limited, Imperial Steel Works, Sheffield, for an important tramway "somewhere in the Colonies." We are informed that this is the largest and most compact lay-out yet made entirely in manganese steel, every part of the job (except fishplates, bolts, tiebars, and connecting boxes) having been made in Allen's Imperial manganese steel.



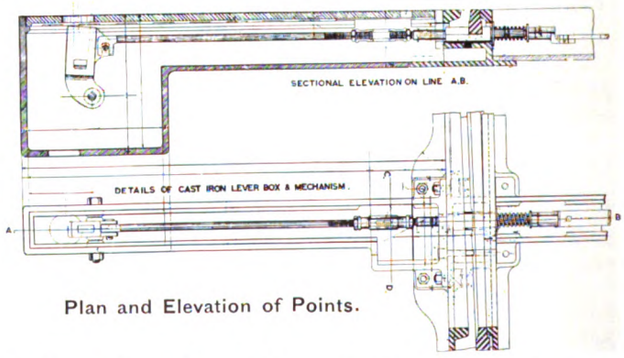
Lay-out for an Important Colonial Tramway.



Enlarged view of Points.

Briefly described, the lay-out is a 4 square with double tracks in all directions, each end of the lay-out forming a 3-way track for cars running through to right or left. There are 16 pairs of points of 100 ft. radius, all facing points having tongues in each point and working together by means of a centre box and connecting bars. The trailing points are also double tongue points, but working independently by means of springs, which are so arranged that only one tongue is in action at once, and this tongue works freely, and is not under the car wheel at the time. The facing points are also arranged so that the tongue can be worked electrically from a signal-box which is to be fixed in a convenient position on the track.

All points are also so arranged that any point can be fitted with a lever arrangement whenever desired, so that while normally working as automatic points, they can at any time have the lever arrangement fixed on the side, and so throw the cars to right or left as required.



Plan and Elevation of Points.

The total weight of manganese steel in the lay-out is 64 tons, apart from accessories. The centre comprises

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some specially intricate compound crossings in single castings, the various groups of crossings being connected by 1,100 ft. of manganese rails to the various points. All the rails were cast straight and then curved to the required radii, the whole forming a most compact and rigid track, occupying an area of 25,600 sq. ft.

BOOK NOTICES.

TRAMWAY TRACK CONSTRUCTION AND MAINTENANCE.*

A book with the above title by R. B. Holt, whose name will be remembered by many of our readers in connection with road-work at Leeds, has recently been published. It is one that may be usefully studied by those about to become responsible for the construction of new tramway track, and, what is much more important in these days, one that may be usefully consulted by those who, being in charge of tramway track already constructed, find themselves confronted with one or more of the manifold defects which this form of permanent way is prone to develop. Electric tramways came into vogue in this country but 15 years ago, and although some experience of them had already been gained in America, the lessons from which probably saved us many costly mistakes, the exigencies of modern conditions of speed and load had not then fully appeared, nor were their effects understood. Indeed, all these 15 years we have been learning them, and the end is not yet, but a stage has been reached when the treatment of such defects has in numerous instances become the main factor in the financial soundness of tramway enterprise. The effect of the war will be to multiply instances of this kind, and there will be numerous examples in the next few years where the avoidance of financial disaster depends on ability to postpone the wholesale reconstruction of worn-out track by nursing the rails and the sub-structure now in operation. Devices and methods innumerable have already been devised to this end, and it is in relation to these methods and devices that Mr. Holt has done what is perhaps his most valuable work. His work has been to separate the good from the bad—those which have emerged successfully out of the test of practice, from those which have failed. This work has been done in a most painstaking manner, and in each case the influence of local peculiarities of circumstance in contributing to success or failure has been duly noted. Many of the author's opinions will be received with lively opposition in certain quarters, and his methods of statement will no doubt be criticised as dogmatic, but he will earn the thanks of new-comers for the trouble and research, and in default of those, the mistakes he thus saves them.

The modern tramway track has to fulfil the function of a railway under conditions of paving which enable ordinary road traffic to proceed simultaneously; out of this circumstance arise nearly all its peculiar and difficult problems. The first constructors of tramways were inclined to a rigid type of construction so as to avoid all movement and displacement in the road. When such roads began to break up under cars of heavy load and high speeds it was contended that the elastic construction of proved efficacy for the railway must be imitated as closely as possible. It was soon seen that elasticity in the track was apt to lead to looseness in the paving, and the history of tramway construction during the past 15 years might be presented as the search for a compromise in the application of these two principles. Mr. Holt points out that a rigid construction is perfectly practical if well constructed and so well maintained that small defects are recognised and remedied at once before they develop into large defects (as occurs with the greater rapidity the greater rigidity of the construction), and gives much valuable information on the early detection of imperfections in the permanent way, as well as the methods to be adopted for eradicating them with economy and despatch. All tramway track problems have been intensified of late by the growing weights and speeds of mechanically propelled vehicles. The examples given of the effects of this traffic on parts of the tramway track not in use for tramway traffic is very instructive. The book may also be consulted with advantage on joint-welding and corrosion of rails. It contains many valuable hints on the arrangement of work in the reconstruction of tramway tracks. The chapter on special track-work is particularly interesting, and contains spiral-tables for curves and junctions which save much labour in setting out these portions of the track. The whole work is presented in a lucid and perspicuous style—a great merit in these days of hurried and inaccurate expression. The illustrations are profuse, pertinent, and well placed in regard to the text. There are copious indices both to the text and illustrations, and there are other indications that an effort has been made to render the book agreeable to read and easy to consult.

* "Tramway Track Construction and Maintenance," by R. Bickerstaffe Holt, Highways and Permanent Way Engineer, City of Leeds. 250 pages, 10×6½×1 in., with over 150 illustrations. Price 10s. 6d. net. TRAMWAY AND RAILWAY WORLD Offices, Amberley House, Norfolk Street, London, W.C.

PERMANENT WAY*.

The seventh edition of the well-known treatise on permanent way of railways, by Mr. W. H. Cole, which has recently been issued, consists of 230 pages and includes 44 line drawings and 30 plates. It is three years since the sixth edition was published, and in the meantime the book has been revised and brought up to date. The author is well qualified to write on permanent way, especially on heavy as compared with light railways, except where the subjects are common to all iron roads. Mr. Cole has passed the curriculum of the Inst. C.E. from student to membership, to which he was elected in 1895. The first edition of the work was completed in November, 1889, at Multan, where the author was assistant superintendent on the North Western State Railway of India, and eventually became deputy manager both of that line and of the Eastern Bengal State Railway. While on furlough in 1885, after seven years' service, Mr. Cole was engaged for some months in passing material for the War Office, and had constant opportunity of observing the process of manufacture which he has described in his first chapter. This will be found most useful and interesting to all those engaged in railways. In this iron and iron ore are enumerated, also the constitution and classification of iron and steel; the impurities are classified, and the inspection and testing of rails and fish plates are described. The author has not much faith in tensile tests, which do not generally agree over different parts of a section, and quotes the late Sir Benjamin Baker's opinion that "tensile and dead load tests are not in themselves such as prove the capability of the rail to stand the strain of loads applied not only instantaneously, but, so to speak, by shocks and blows." In the impact test, on the other hand, "the falling weight attacks the metal suddenly and severely, as it is tried in actual use, and shows at once whether the steel is too hard or too soft." A useful formula is given in Chapter IV., to find how much a rail should be bent to suit a curve—but in the chapter on rail sections no tramway rails are mentioned. It will be seen that Mr. Cole acts consistently and successfully up to his motto, *mente manuque*.

MUNICIPAL ELECTRICAL ASSOCIATION.

The Editing Committee of the Incorporated Municipal Electrical Association have issued, at the price of 5s., the proceedings of the twentieth annual meeting of this Association, held at the Institution of Electrical Engineers in June last. The volume of 209 pages contains the full text of the several papers which were submitted, including the illustrated paper on "The Use of Electric Vehicles in Municipal Service," written by Mr. F. Ayton, electrical engineer and tramways manager to Ipswich Corporation. This paper has been widely noticed both in this country and in the United States. Full reports of the various discussions are also given, together with the annual report of the Council. It is important to note an expression of regret by the Council that municipal electrical undertakings have made a very poor response to the appeal for funds published by the Engineering Standards Committee, upon which the Association is represented by two members. The work of that Committee is of the utmost importance to electrical undertakings, for the standardisation of apparatus cheapens the cost of its manufacture and reduces the time taken in the preparation of specifications by the engineers in charge of electricity undertakings. 166 Electricity Committees are members of the association, including Melbourne, Australia. Numerous tramways that are conducted jointly with electrical undertakings are among the members, and others are represented on their own account.

WIGAN TRAMWAYS ARBITRATION.

Sir George Askwith, Sir David Harrel, and Sir George Gibb, constituting the Committee of Production appointed by the Government to arbitrate on labour disputes during the war, have issued their award in respect to an application made by the employees of Wigan Corporation Tramways for an advance of wages. A bonus was granted in April in reply to an application for improved conditions made in March last, but in July the men again applied for increased wages, and finally ceased work. At the hearing by the Committee of Production information as to scales of pay at towns in Lancashire was produced by both parties and considered, and the representatives, of the Corporation stated that they were prepared to offer to conductors an increase of ½d. per hour at each stage of the scale of pay, making the rates (without bonus) 5½d. per hour on appointment, 5½d. per hour after 12 months' service, 5¾d. per hour after two years' service, with a maximum of 6d. per hour after five years' service. The finding of the committee was that having regard to the present scale of pay and the "war bonus" which had been granted, the wages of conductors should be advanced in accordance with the offer of the Corporation, ½d. per hour as from the first full pay week following the date of this decision, the wages of the other grades to remain unaltered.

* "Permanent Way," by W. H. Cole; crown 8vo., 7s. 6d. net; E. & F. N. Spon, Limited, 57, Haymarket, London, S.W.

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THE OPENING OF THE FIRST TRAMWAY IN EUROPE.

Mr. T. B. Goodyer, in an article printed elsewhere in this issue, refers to the construction of the first Birkenhead tramway, which was then described, and apparently with truth, as the first street railway in Europe. As Mr. Goodyer points out, the inception of the Birkenhead tramway was due to that eccentric and flamboyant American, George Francis Train. He came to England in 1859, and set himself to introduce improved means of public street transit. The first place in which he was successful in coming to terms with the local authority was Birkenhead, and on August 31, 1860—just 55 years ago—" the first street railway in Europe," a short line from Woodside Ferry to Birkenhead Park, was opened for public traffic with much pomp and ceremony.

The street railway cars, each drawn by two magnificent horses, commenced running at ten o'clock on the opening day. At half-past one o'clock, all the four carriages (with a band of music on the first one) drew up at the Woodside Ferry to receive the principal guests invited to the banquet given by Mr. Train to celebrate the great event of the day. By this time the whole of Birkenhead was in an unwonted state of excitement, and as the cars smoothly glided through the streets, the only noise heard was that of the musically-toned bells on the horses collars. In the first day the cars conveyed 4,300 passengers.

The successful opening and inauguration of the first Cis-Atlantic street railway was appropriately celebrated by a splendid *dejeuner*, which was given by Mr. Train in an impromptu banqueting hall (erected for the carriage depot) in the yard of Mr. Main, the builder of the cars. About 350 persons were present.

The invitation card, the design of which was worked out in gold and colours, was an elaborate production. It bore a good deal of letterpress, of which the following is part :—

" Its (the tramways) advantages are :—Saving of time—no jolting—less confusion—less noise—fewer accidents—no mud—less dust—more regularity—more attention—more comfort—better light—better ventilation—greater facility of ingress and egress—in short, superiority in every respect over the old omnibus. Saving of rates and increased value of property mark its introduction. Ladies welcome it—children enjoy it—it is the rich man's comfort—the working man's luxury."

These splendid and novel invitations—so the narrative proceeds—were sent to all the monarchs of Europe—except the King of Naples—to Garibaldi, and to the elite of Great Britain. At the *dejeuner* a printed toast list supplied to each guest included some paragraphs from which the following is taken :—

" Street railways to-day have a local habitation and a name in England. Twelve hundred invitations record the fact. Wise men have come from the east, and the west, and the north, and the south to honour the occasion of their introduction into the Old World. Innovation is the order of the day. . . . Why not innovate the toasts a little ? Instead of the old-fashioned lumbering omnibus style of after-dinner speaking, let us introduce the elements of enjoyment and good nature. . . . To enjoy ourselves the first step is to lay aside the usual formalities and become acquainted. . . . This is a street railway entertainment, and everything is organised on a street railway principle. The regular toasts are few in order to make room for the many volunteers. Good speakers and good singers are present. Five-minute speeches will allow all who wish to speak. Suggestions to the chair will be appreciated. Don't leave the table if you can help it, and when the ranks get thin, close up."

The chronicler of the function adds that on the last page of the toast-list were the simple but suggestive words of the great Cæsar, *Veni, vidi, vici*.

Mr. Train, in responding to the toast of " The Chairman," made an extraordinary speech, from which we quote the following :—

One would have supposed that a really good thing in this live age of competition would have been at once adopted ; but I assure you Bunyan's pursuit of knowledge under difficulties was nothing to my endeavour to introduce into the old world one of the greatest luxuries of the new. When I found there were no more contracts to make for the Italian Army, I left France and went to America last year, to look after the extensive domain, near an Atlantic city, of one of the royal families of Europe. The first thing I saw in Boston were street railways. They met me everywhere—street railways in New York, street railways in Baltimore, street railways in Cincinnati, street railways in Philadelphia, street railways in St. Louis, and street railways in Chicago. Why are they not in Europe, I asked myself ? but could give no answer. One reason was that everybody was occupied—nobody had time and nobody had money. Observation has taught me that the higher you go in life—socially, financially, commercially and politically—the shorter people are. (Laughter.) Everybody seems hard up.

Then it was that I sold myself to an idea. The more I reflected the firmer was my conviction. Some bankers joined me, but only for London, Paris, and St. Petersburgh. Never mind—the instinct got complete control, and out I came, arriving in the Mersey in October last. Then came the tug of action. I argued, I explained, I reasoned, but to little purpose. Pamphlets, letters, engravings I threw off by the thousand. Knowing that the tongue and pen were the battering rams of good or evil ; knowing that thinking men were persecuted and inquiring minds thumbscrewed in every age, I stuck by the ship. (Applause.) I went to Paris. The Emperor was too busy with the armies. I came to England ; London was too conservative. Liverpool seemed asleep. Time pressed—weeks flew past—months were going and money too, when instinct again pointed to Birkenhead. Practical men met me in a practical way. I showed them my cards. Will you take all risk ? Yes. Will you pay all legal damages against the Commissioners ? Yes. Will you repave the streets at your own expense, pay for lighting and watching the road during said work ? Yes. Well, you know, Mr. Train, we are business men representing a business community ; what security will you give ? We don't know you personally. Anything you like, gentleman ; say the rails, the timber, the material, or the ground. No, that won't answer. What then ? Three thousand pounds. " Three thousand ducats—well ! " (Laughter.) All right, you shall have it in sovereigns or consols, and to-day, if you say so. I pay the money, and you take your choice. (Great applause.) Hedged in with conditions—bound down with legal ties, I went at it without one word of actual sympathy or encouragement.

I kept my own counsel, and amused myself by noticing the shrugs and winks of the doubters, and in listening to the sneers of the sceptics. Knowing that it was a great natural law that a man was not a prophet in his own country, or among his own friends—firmly believing that the good advice of one's friends is perfectly suicidal to one's success—(loud laughter)—I made up my mind to accomplish whatever I undertook, one of the most serious of my many faults being the Herculean idea I had of my own ability. (Laughter). I believe in destiny, but it must be backed up by patience, perseverance, and pluck. (Applause.) I believe in a star, but it must be endorsed by faith, hope, and energy. I knew the better the invention, the more severe the opposition—that this was not opposed for its impracticability, but for its practicability.

Opening of Birkenhead Tramways, August 31, 1860.

As one fact was better than one hundred analogies, I built this road (and the Commissioners say I have done it well—they are all present, ask them), most people looking upon me as a harmless lunatic, growing saner and saner, however, as I progressed towards completion. Rumours every day came out—another omnibus broke—another horse fell on the rails—another gentleman's carriage wheel wrenched off. Then stories of injunctions, prosecutions, mandamuses ; but what of that ? A regiment of bayonets, a battery of rifled cannon, would not have deterred me, had street railways been behind them (applause) ; hence, these Lilliputian popguns, revolvers, and muskets of opposition were only pepper and mustard to my roast beef. (Applause.) To-day I hear nothing of the noble army of martyrs. (Laughter.)

Birkenhead has to-day introduced Free Trade into locomotion. (Cheers.) Is it popular ? Go and ask the labouring man employed in making the road—in cutting the timber—in casting the iron. Go and ask the navvies who have so well earned my money, if street railways are not a blessing to the community ? (Applause.) Satiated with commendation, censure was gratifying, more especially as the rotten eggs of slander and the dead cats of sarcasm are always hurled at innovators in every land. (Laughter and applause.) Week after week I paid the workmen—fifty to eighty a day. Where does the money come from ? asked one. Will it succeed ? inquires another. Why make such liberal offers to the Commissioners ?—because I wanted despatch. Will it pay ? says a third. Why interest yourself on that subject ? I don't ask you for any money ; the best evidence that I think so is that I run all risk. Others seem astonished to see me patent the whole principle. They should

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know that "priority" itself is a "freehold" under the primogeniture laws of England, and I am 12 months ahead.

With priority—with money—with the patent—with the knowledge, and having full confidence in my engineer, Mr. Palles, who came endorsed to me from Philadelphia, I never turned to the right or the left. The result you see to-day. I knew I had the most profitable idea of this generation, and that little by little I could disarm prejudice; little by little an acorn makes an oak, sand by sand the insect makes a coral mountain, drop by drop the ocean is created, stone by stone Cheops was built—so argument on argument, word by word, I have worked street railways into Birkenhead. (Cheers.)

Street railways were just ready for importation when I went to America. Not wishing to forget the seed time and harvest—to neglect the tide and lose the voyage, I determined to carry my point. I have done so; but it has been uphill work—those who have ears would not hear, eyes would not see. Some talked large but did nothing. Others in this case thought me mad; a large-brained member of Parliament (Wm. Jackson, Esq., M.P. for Newcastle) cautioned me against talking so strong, urging that he did not dare to introduce me to his friends. When the Irish Committee (some dozen M.P.'s, headed by Mr. Cardwell) came to see my models, I told them how I had been crammed for the interview, I was told I must talk with great precision and dignity; I begged them to let me talk naturally first, and then I would assume the dignity if they desired it. Innovation is my creed; something new was wanted; all were wedded to old forms. I obtained opinions from intelligent men, and whenever they all concluded that the whole thing should be arranged one way, I was sure to order it just the reverse. (Laughter.) Here are some of the innovations. The rail, the sleeper, the carriage opening at each end; the rules printed for drivers and conductors; bells on the harness, but no blinders on the bridles; uniforms for the drivers and conductors; large horses; new style of banquet card; order of toasts introducing the Prince of Wales, and placing the Press where they ought to be—up among the sovereigns. (Cheers.) New fashions come in hard.

Wishing to make sure that I alone had faith in what I was doing, I spoke about raising some money. Like Copperfield trying to sleep with one eye open, I found it could not be done. (Laughter.) The thing was untried. My timber merchant stood with a sleeper in one hand and the bill in the other. (Loud laughter.) The Birkenhead ironfounders the same. One and all said—Your money or your life. My highly conservative solicitors looked on, it seemed to me, more in sorrow than anger, at what appeared to them a reckless speculation. (Laughter.) The only live man in the whole party seems to be the carmaker, Mr. Main. He had faith. (Applause.) The fact is, I did not want their assistance, for I had £30,000 as a nest-egg to begin with. (Applause.) I only wished to try them. (Laughter.)

I went to Birmingham, where I met some live men. Two days were enough for them to give me the grant; then to Manchester, where the men were liver still; two hours did it; then to London, where the Marylebone Committee settled the question for Oxford Street in 60 minutes by the clock. (Cheers.) Under these circumstances it is proper to state that I have changed my politics—radical at first, I am now conservative; radical before dinner, conservative after dinner; radical before success, conservative after gaining the case. (Laughter and applause.) Believing that the democratic party has got no friends, and as the doctrine of averages is against another democratic President, I think I shall join the other side. Self-preservation prompts a man to leave a sinking ship. (Laughter.) When I go to Congress my ambition will be to join the party that wins. (Laughter.) Great enterprises often fail, for two reasons. First, anxious to build them up, the promoters make rash promises which they never keep. Second, they do not consolidate as they go. Knowing these rocks, where so many have foundered, I shall keep mid-channel, and, by dealing on the square with all, shall endeavour to prevent my little puppy from becoming somebody else's dog. (Loud and continued cheering.) In thanking you for this splendid demonstration of the goodwill of Englishmen for my country, I am more than ever convinced that—

"Though oceans roll between us—though our lands are far apart,
Though rival mothers bore us, we are brothers still at heart—
Let us think upon the ancient blood that circles in our veins,
And drain the cup of fellowship while yet a drop remains.
Here's health to hallowed Albion, the jewel of the sea,
And her daughter, fair Columbia, the happy and the free:
Long may their sons their praises sing in friendship's joyful strains,
And drain the cup of fellowship while yet a drop remains."

(Enthusiastic applause.)

Melbourne Tramways Lease.—The lease of the Melbourne Tramway and Omnibus Company, which controls all the tramways in the city, expires on July 1, 1916. In the Greater Melbourne Bill, which is before the Legislative Assembly, it is proposed to empower the Council to acquire the undertaking by agreement or compulsorily.

LINKING UP OF LONDON ROUTES.

TRANSFER AND CHILDREN'S TICKETS FOR TRAFFIC DEVELOPMENT.

Following an inspection by Colonel von Donop, R.E., of the Board of Trade, the London County Council Tramways department brought into use on August 16 the short length of line constructed round Forest Hill railway station for the purpose of joining up the London County Council tramway termini in London Road and Park Road. The former was the terminus of the Embankment–Forest Hill route *via* Camberwell, Denmark Hill, Dog Kennel Hill, and Lordship Lane, while Park Road was the termini of the Catford–Lewisham and Brockley–Lewisham routes to the Embankment.

The steep gradient of Dog Kennel Hill is remarkable for possessing a quadruple track, in order to prevent the possibility of an accident. This track was illustrated in our issue of December 12, 1912.

Before the new link could be constructed, two sharp curves and narrow lengths of street had to be rectified by demolitions and widenings, while under a railway bridge and elsewhere the road had to be lowered several feet. Although the new line is less than 200 yards in length, the cost of the work has been about £40,000. The linking up provides passengers in all parts of Forest Hill with an addition to their choice of routes for reaching the City and the West End. The extra route is obtained by an extension of the Victoria–Forest Hill service (No. 58) to the Blackwall Tunnel, the through ordinary fare being 3d. single and 5d. return. The single journey is nearly 11 miles, and it is the second longest trip that can be obtained on the Council's tramways without making a change of car. The record distance is the 13 miles between Waterloo Bridge and Abbey Wood, for which the fare is 3d. single, while the double journey can be undertaken for 5d. Efforts are made from time to time to popularise this route for outings, as just outside Woolwich there are the attraction of Bostall and Abbey Woods.

Another linking up was effected during July between the Embankment–Wandsworth and Tooting–Wandsworth sections and the line that crosses Putney Bridge to Hammersmith and Harlesden. A track less than 300 yds. in length has effected this linking up in Wandsworth High Street. Here again the difficulties attending the carrying out of street improvements have delayed a very necessary work. When the war has ended and the Oxford and Cambridge boat race is revived, there will be tramway facilities from the Embankment to Putney. Long before that time yet another joining up of lines will have been effected in this locality, viz., from Clapham Junction and East Hill to Wandsworth High Street. The link will be under a quarter of a mile in length, but street widening in a thoroughfare reminiscent of a market town is an obstacle that is now being overcome. The scheme will about complete the list of dead-ends that can be abolished without further Parliamentary powers.

By gradual steps during the past two years or so, the tramways department have been rendering transfer facilities of increasing advantage to the public. Since the introduction of return tickets, passengers have been able to introduce pleasure into their rides by using them on other lines for the return journey for a corresponding distance, and then walking to their homes. The transfer ticket system has increased the utility of the tramways both for business and pleasure, and it has also served to make better known the existence of the Embankment and Aldwych subway as a connecting link between the northern and southern systems. A further concession is seen in the current announcement that until further notice transfers will be available for transfer at any tramway junction *en route*, provided only one change of car is made in order to reach the desired destination. One effect of this will be to relieve congestion at some changing places by enabling passengers to proceed to another route where there is a better service of cars before they make a change.

Considerable success is attending the institution of cheap fares at all hours for children under 14 years. These fares apply to single journey and transfer stages, and the effect of the concession has been to increase the number of passengers during the slack hours while the holidays are on.

Effect of the War on Berlin Tramways.—The Grand Berlin Tramways Company has severely felt the effects of the war. The receipts of the company and its associated undertakings for the first half of the present year decreased nearly 7 per cent. as compared with the receipts for the first half of the previous year. In the case of the underground and elevated electric railway the receipts fell 25 per cent., and those of the Berlin Omnibus Company nearly 50 per cent. Probably some of the traffic was diverted from the railways and the omnibuses to the tramways, as a large number of the omnibuses were impressed. The tramways company proposes a revision of its fares, and the scheme is now receiving official consideration. The cost of materials has risen, and grants to employees and to dependents of employees are estimated at £75,000 per annum.

Pressing for a Tramway Extension.—In consequence of the delay in the completion of the Doncaster tramway extension to the Brodsworth model village, the Town Council have asked Sir Charles Nicholson, M.P., to interview the President of the Local Government Board. They state that the people have suffered long enough.

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NOVEL TRAMWAY ADVERTISING.

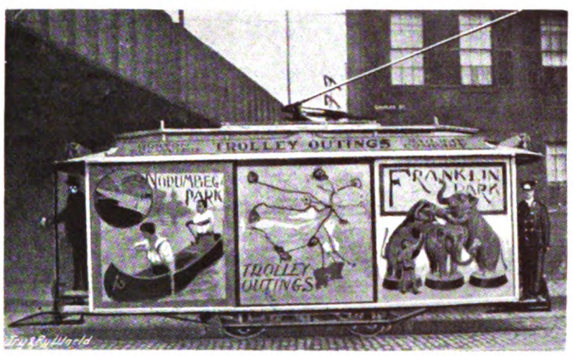
For the purpose of stimulating traffic during the summer months the Boston (Massachusetts) Elevated Company has conducted an interesting publicity campaign that includes some original ideas. The most unusual feature is a single-truck car on each side of which are carried three large oil paintings more than 6 ft. square that are both striking and artistic. These paintings advertise points of interest in the vicinity of Boston reached by the Elevated Railway and connecting lines. The pictures are done in poster style by a well-known decorative artist of Boston. Out-of-door life and attractions, that make a strong appeal to most people during the summer months, furnish the theme for each of the paintings, and the work has been done with a few strong, harmonious colours that produce a highly decorative effect and compel attention.

Franklin Park, a municipal recreation park, contains among other attractions three performing elephants that were purchased by Boston's school children and given to the city. These have been used for the subject in the picture advertising that resort.

Two children playing in the sand on the beach at Marine Park, South Boston, is the principal subject of another painting, in which there is inserted a striking picture showing the brilliantly hued tropical fish that are exhibited at the aquarium included in this park. Another picture advertises Lexington Park and shows a young couple dancing in the pavilion, and contains in one corner a picture of the head of a buffalo of the zoo. On each side of the car in the central square is a large map showing points of interest that may be conveniently reached by trolley trips and indicating the route and connection by small lines in the usual style of map drawings.

The car is illuminated by a row of overhead lights at night and although put in operation for the first time Tuesday, July 13, has already attracted a great deal of attention and been widely noticed in American newspapers, from one of which, the *Electric Railway Journal* (New York), these particulars and illustrations of the car have been reproduced.

Besides the advertising car the company is publishing a series of small 1-in. single-column display advertisements on the front page of the Boston daily papers. These advertisements are run every Sunday and every other day on week days in each of the papers. They call attention to places of interest in short, pithy sentences in simple, direct language.



Tramway Car Advertising "Trolley Outings."

ANIMALS, BIRDS AND FISHES

Interesting collections of birds and animals may be found at Franklin Park, Norumbega Park, Lexington Park and Middlesex Fells. A remarkable collection of brilliant-hued fish may be found at the Marine Park Aquarium. These are all delightful places for spending a summer afternoon or evening.

CHILDREN'S OUTINGS

Take the children to see the animals and birds at Franklin Park, Norumbega Park and Lexington Park, and the fishes at Marine Park. These parks are beautiful, cool and safe for children.

GO TO THE WOODS

There are many beautiful tracts of woodland within a few miles of Boston famous for their charm, including Middlesex Fells, Stony Brook Reservation, Norumbega Park, Blue Hills, Dorchester Park and Lexington Park.

TYPICAL SMALL ADVERTISEMENTS INSERTED BY BOSTON ELEVATED RAILWAY COMPANY IN LOCAL NEWSPAPERS.

The company is also using large 5 ft. × 7 ft. printed posters mounted upon upward of 150 bill boards owned by the company on different parts of the system. These posters enumerate various points of interest on the company's and connecting lines and announce the attractions to be found at each place. The posters are changed monthly.

WOMEN AS CAR CONDUCTORS.

Scarcely a week passes without an addition to the tramways undertakings employing women as conductors. In Portsmouth a colonel's daughter and a captain's wife are employed on the cars, and are giving their wages to charitable institutions. By coming forward they have released men for service with the Forces.

At Coventry, a Nonconformist minister is discharging the duty of a motorman, and at Newcastle-on-Tyne a considerable number of business men have been engaged for two months past on the early morning cars conveying munition workers. Not long ago Cardiff Tramways Committee appealed to the citizens for similar aid, but the extent to which they have responded has not yet been stated. A significant move at Newcastle is that the male employees' trade union has been at work amongst the women conductors and car cleaners. The result was seen on August 26, when a deputation of the women, accompanied by the union secretary, asked the Tramways Committee to grant a war bonus of 2s. 6d. a week for householders and 1s. 6d. a week for non-householders, and a minimum wage. The conductors also asked for time and a quarter for Sunday labour, and the cleaners made a request to be provided with rubber shoes, as well as overalls, when engaged at the carsheds. A further demand was for free passes on the cars while journeying to and from work. The various requests are under consideration.

Manchester is the latest city to experiment with women as conductors, who already number 55 in the adjoining borough of Salford. In asking the Tramways Committee to sanction the departure, Mr. McElroy, the general manager at Manchester, stated that 2,013 of the 5,000 employees a year ago have joined the colours, and that the men remaining in the service have worked magnificently. He finds now that the number of men physically unfit for military service has become exhausted as a recruiting ground for tramway labour, and that the department cannot go on any longer under the existing conditions. Glasgow now has 700 women conductors, and Leicester is likely to be the next undertaking to adopt the wartime innovation, which is common in France, Germany, Italy, and Austria. Despite the steep gradients at Halifax, the chairman of the Tramways Committee has stated that the shortage of men may necessitate the engagement of women as conductors. Among municipal undertakings of the front rank in the provinces Liverpool, Leeds, and Bradford are the only places where the aid of women has not been sought. At Liverpool and Bradford the hilly nature of the routes is the objection, but at Sheffield this difficulty has not prevented women from being employed. Women cleaners, however, are engaged at Liverpool. The chairman of the Leeds Tramways Committee has expressed doubt whether women would be available in that city, owing to the great demand which exists for the work of women in connection with munitions. Amongst the company-owned tramways, Edinburgh is prominent for the employment of females. In London several applications have been made to the police to license women as conductors without success. The only alternative which Scotland Yard can suggest is that invalided soldiers should be employed. Numerous tramway undertakings have already tried that expedient, for managers have always recognised that men from the services make the best employees. Unfortunately, most of the gallant men now find themselves unable to stand the strain of tramway work, and they have had to be found lighter jobs. It is astonishing that Scotland Yard should set itself up against the experience of the great provincial tramways, where traffic is as heavy as upon any London route. In Paris, too, there are 600 women performing the work of conductors.

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FINANCIAL REPORTS AND MEETINGS.

Straker-Squire (1913), Limited, have declared a dividend of 1s. per share.

Halley's Industrial Motors Company.—Interim dividend at the rate of 10 per cent. per annum, free of tax.

Glasgow Subway Railway Company have declared an interim dividend at the rate of 2 per cent. per annum.

Para Electric Railways and Lighting Company, Limited, is not paying an interim dividend on the ordinary shares.

Blackpool and Fleetwood Tramroad Company.—The usual dividend at the rate of 4 per cent. for the half-year ended June 30 has been recommended.

Oldham, Ashton, and Hyde Electric Tramways.—An interim dividend of 5 per cent. per annum on the ordinary shares for the past half-year has been declared.

British Electric Traction Company.—At a confirmatory meeting held on August 9, the proposals for the reduction of capital were passed by each class of shareholders by majorities largely exceeding the required three-fourths.

Stewarts and Lloyds.—Interim dividend at the rate of 10 per cent. per annum on the preferred ordinary shares for the half-year ended June 30. A year ago the distribution was the same, and 6d. per share was paid on the deferred shares.

Guest, Keen and Nettlefolds, Ltd.—The directors recommend the payment of final dividends as follows:—Preference shares at the rate of 5 per cent. per annum for the half-year ended June 30; ordinary shares at the rate of 10 per cent. per annum, together with a bonus of 1s. per share on the ordinary shares.

Millars' Timber and Trading Company.—Mr. James White, presiding at the annual meeting of Millars' Timber and Trading Company, on August 9, said that for the past year profits were only £691 less than in the previous year. As long as the war lasted all the company would be able to pay were the preference charges, nor when the war was over would it be judicious to suppose that there would be an immediate revival in the business of the company.

South Shields Corporation Tramways.—For the year ended March 31 last, the total income was £39,845, and after meeting all expenses of working, there remained a gross balance of £14,335. Of this amount, £8,741 has been absorbed by interest and sinking fund charges, leaving a net profit of £5,594. The sum of £2,400 has been contributed to relief of the rates, and £3,194 to the reserve fund, which has now reached £28,337. The electricity undertaking made a profit of £3,200, of which £1,600 has been paid in relief of the rates. The balance is to be placed to reserve.

Dublin and Blessington Steam Tramway Company.—The report for the half-year ended June 30 shows that the gross receipts amounted to £3,423 and the expenses to £4,520, being a loss of £1,097 for the six months, as compared with £426 for the corresponding half of 1914. The company anticipated that the two petrol-electric cars which have been on order since last autumn would have been working in May, but owing to the claims of the Government the manufacturers were unable to deliver them, and the delay had caused a considerable loss in the company's receipts and dislocation of the service.

Renewals Fund at Wolverhampton.—Alderman Sir Charles T. Mander, chairman of the Tramways Committee, in submitting the annual report of the undertaking, stated that the cars ran 14,000 miles less than in the preceding year, which was due to the war. The total expenses were £1,940 more than last year, or nearly ½d. per car mile, while the receipts were £1,881 less, meaning a difference of £3,821 on the gross profits. As a result there was only £13,275 net revenue, as against £17,037, and they could only put £396 to renewals fund, as against £3,716. That did not matter very much, as the renewals fund amounted to £53,987.

Manaos Tramways and Light Company.—The report for the year ended April 30 states that the gross receipts amounted to £110,420, a decrease of £22,457. The expenses were £84,240, a decrease of £12,608; and the net earnings £26,180, a decrease of £9,848. The fall in exchange has resulted in a loss of £6,180 on remittances. After providing for interest, London charges, etc., placing £1,725 to debenture sinking fund and £300 to depreciation on furniture, there remains a profit balance of £4,002 to be carried forward. The State, Federal and Municipal Governments are still in arrears with their accounts, although as a result of strenuous efforts some collections have been made during the year.

Gloucester Corporation Tramways.—The traffic revenue for the year was £17,806, as compared with £18,017 in the preceding year. The operating expenses amounted to £13,704, compared with £13,881. The aggregate repayment of capital to date amounts to £25,212. The passengers carried during the year were 4,358,510. The average traffic revenue per car mile was 6·41d., and the average total revenue 6·84d. per car mile. The average operating expenses, inclusive of power cost, were 5·26d. per car mile. The gross profit was £4,102, compared with £4,136. The amount provided to balance the net revenue account from the city rate was £3,510. The reserve and renewals fund amounts to £1,000.

West Hartlepool Corporation Tramways.—The total revenue during the past year was £19,505 and the operating expenses £11,574. Gross profit totalled £7,931, and net profit £3,018, or an equivalent of 3·69 per cent. on the capital outlay. Compared with the previous year the revenue shows an increase of £1,911. The total power expenses decreased by £452, which sum more than covered the capital charges on the new feeders between Burn Road station and the tramways, while in addition the undertaking had the benefit of higher voltage. This factor was of considerable importance in enabling the Seaton traffic to be catered for to a much larger extent than formerly. The percentage of working expenses to receipts was 59; average working expenses per car mile 5·80d.

Water Power at Chester.—The year's working of Chester Corporation hydro plant, which provides current for traction, power and lighting, shows a gross profit of £12,483, and a net profit of £3,194. A sum of £6,933 was contributed out of revenue to the capital expenditure. The report of the auditor stated that after debiting interest and sinking fund charges on loans and the revenue contributions to capital expenditure and allowing ·632 per unit for the sale of electricity generated at the hydro works, the surplus for the year was £2,974. In reply to a critic's statement that the hydro works had not led to the anticipated reduction in charges, the chairman of the committee stated that the undertaking had made as good a show as could be expected in view of the war.

Capital for L. & N.W. Suburban Electrification.—Resolutions were passed at a special general meeting of the London and North-Western Railway Company authorising the directors to create and issue new 4½ per cent. preference stock, not exceeding in the aggregate £1,500,000, redeemable in 1925. Mr. C. N. Lawrence, who presided, said that they were compelled to adopt the course in consequence of the abnormal condition of finance at the present moment. The stock was required for the completion of the Euston and Watford electric railway, and also for sundry works in connection with Holyhead. For those investors who retained their stock until maturity, he was informed that at the price of issue, namely, 96 per cent., it would pay them somewhat over 5 per cent. per annum. The issue was over-subscribed.

Competition at Walthamstow.—In submitting his annual statement on the tramways undertaking for the year 1914-15, Councillor W. R. Clarke, chairman of the Committee, remarked that the year had been in some respects the most successful the undertaking had had, although there was an adverse balance of £3,500. The traffic receipts were £41,343—the highest yet attained, and £2,757 above the preceding 12 months. The average receipts per car-mile were 8·65d., as compared with 7·94d. in the previous year. The passengers carried numbered 13,500,000, an increase of 920,000. Councillor Wilkes asked if the inhabitants understood that the tramways were their property, and that they had to make up any deficiency. If they had that knowledge there would not be so many omnibuses running. Councillor Fellingham said the omnibuses had woke up the tramways undertaking.

Sensible Finance at Dundee.—The annual statement made by Councillor G. A. Johnston, chairman of Dundee Tramways Committee, in presenting the annual report of the tramways undertaking, showed that since municipalisation 16 years ago the capital expenditure had been £371,145. The amount of debt redeemed by sinking fund was £96,762; the amount at credit of depreciation, reserve, and renewals, £83,515; while the accident insurance fund was £9,179, making a total of £189,356, and leaving £181,689 of unredeemed debt. Considerably more than half of the total capital expenditure had already been wiped out. For the past year the revenue was £68,274, and the expenses £43,358, leaving a surplus of £24,916. After making full provision for sinking fund contributions and payments to the depreciation and renewals funds, and giving £1,000 to the Common Good, there was a surplus of £60.

Aberdeen Corporation Tramways.—In his annual report Mr. R. Stuart Pilcher, the general manager, records that not only were the receipts for the year ended May 31 the highest the undertaking has known in its 16 years' existence, but that the takings were still showing an increase in the current year. The appended table gives a comparison for the past two years:—

	1914-15.	1913-14.	Inc. or Dec.
Capital expenditure	£366,332	£356,082	+ £10,250
Amount outstanding	£181,707	£186,885	− £5,178
Traffic revenue	£86,614	£84,276	+ £2,338
Total revenue	£88,002	£85,266	+ £2,736
Working expenses	£51,525	£47,036	+ £4,489
Gross balance	£36,477	£38,230	− £1,753
Net profit	£11,000	£12,989	− £1,989
Passengers carried	24,048,816	22,218,142	+ 1,830,674
Fare per passenger	·86d.	·91d.	− ·05d.
Car mileage	1,909,009	1,832,587	+ 76,422
Units per car mile	1·213	1·184	+ ·029
Traffic receipts per track mile	£3,121	£3,064	+ £57
Traffic receipts per car mile	10·80d.	11·04d.	− 0·15d.
Expenses per car mile	6·48d.	6·16d.	+ ·32d.
Ratio of working expenses	58·54	56·16	+ 2·38
Total track mileage	27 m. 72 ch.	27 m. 56 ch.	—
Number of cars in stock	83	77	+ 6

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Halifax Corporation Tramways.—The accounts for the past year show that the revenue and profit were considerably in excess of the amounts for the preceding year. The working expenses showed an increase of only £231. Other details are appended :—

	1914-15.	1913-14.	Inc. or Dec.
Capital expenditure	£420,185	£419,335	+ £850
Amount outstanding	£283,249	£297,327	− £14,078
Total track mileage	55 m. 867 y.	55 m. 867 y.	—
Number of cars in stock	101	101	—
Traffic revenue	£111,792	£108,617	+ £3,175
Total revenue	£113,170	£109,650	+ £3,520
Working expenses	£73,504	£73,273	+ £231
Gross balance	£39,666	£36,377	+ £3,289
Net profit	£16,211	£13,643	+ £2,568
Passengers carried	20,707,071	20,276,077	+ 430,994
Fare per passenger	1·27d.	1·26d.	+ 0·01d.
Car mileage...	2,330,104	2,242,086	+ 88,018
Units per car mile	1·98	1·94	+ 0·04
Power cost per car mile	2·22d.	2·18d.	+ 0·04d.
Traffic receipts per track mile	£2,015	£1,958	+ £57
Traffic receipts per car mile	11·51d.	11·63d.	− 0·12d.
Expenses per car mile	7·57d.	7·84d.	− 0·27d.
Ratio of working expenses	65 p.c.	67 p.c.	2 p.c.

Sheffield Corporation Tramways.—An interesting situation is disclosed from the appended figures abstracted from the annual report of the Tramways Committee. Half-way through the year the tramways power station was transferred to the Electric Supply Department with a consequent decrease of £4,342 in the service of debt. The power cost per car mile increased by ·240d. The average cost per unit before the transfer was ·471d. and for the second half of the year ·754d. Doubtless the higher cost of coal is responsible for the increase.

	1914-15.	1913-14.	Inc. or Dec.
Capital expenditure	£1,425,664	£1,388,857	+ £36,807
Amount outstanding	£1,122,482	£1,073,612	+ £48,870
Total track mileage	79 miles	79 miles	—
Number of cars in stock	339	335	+ 4
Traffic revenue	£391,482	£386,059	+ £5,423
Total revenue	£396,229	£392,397	+ £3,832
Working expenses	£246,829	£232,761	+ £14,068
Gross balance	£147,701	£156,915	− £9,214
Net profit	£69,939	£77,607	− £7,668
Passengers carried	107,023,195	104,851,408	+ 2,171,787
Fare per passenger	·878d.	·884d.	− ·006d.
Car mileage...	8,810,252	8,883,576	− 73,324
Units per car mile	1·979	1·933	+ ·046
Power cost per car mile	1·189d.	·949d.	+ ·240d.
Traffic receipts per track mile	£4,950	£4,885	+ £65
Traffic receipts per car mile	10·664d.	10·430d.	+ ·234d.
Expenses per car mile	6·568d.	6·288d.	+ ·280d.
Ratio of working expenses	61·116	59·732	+ 1·384d.

Sir William Clegg, in submitting the accounts to the Corporation, said that the service had been satisfactorily maintained in spite of so many men having joined the colours, the enlisted conductors being replaced by women. The number of passengers had increased enormously, the increase during the past four weeks having been nearly a million. The Tramways Committee had come to the conclusion that it was not to the interest of the travelling public that an increase in fares should be made. This year the expenditure in providing for the dependents of men who had joined the forces would amount to nearly £12,000, and the cost of materials was going up, but with economy of working they hoped to be able to hand to the Finance Committee a sum equal to that given for the past year, viz., £22,876. The department has 1,817 employees.

Tyneside Tramways and Tramroads Company.—The half-yearly meeting was held at Newcastle on August 10, Dr. J. T. Merz (chairman) presiding. The chairman said the revenue had been £400 less than the corresponding half year, and the profit had been almost exactly the same as last half year. The receipts had been less, because a very large item in the receipts in the first half of the year was usually the holiday traffic. They had lost in that way £1,457, but they had made it up by about £1,000 in the ordinary traffic, which had been larger owing to the increased workmen's traffic. Fewer cars had been run owing to the reduced staff. The receipts per car-mile had gone up from 10·48d. to 11·06d., and the expenses from 6·58d. to 7·15d. Their men had been very loyal and worked a considerable amount of overtime. The dividend was the same—at the rate of 3 per cent. The reserve fund amounted to £20,666. They had invested £20,306, but against that they had a debit of £4,000 owing to the bank. They would hold over £9,000 in the war loan, which would be nearly half of the reserve fund. This would mean an increase in income of £23. They insured against aircraft and bombardment for £20,000, at a cost of about £86. The traffic receipts, he added, were still going up. On the motion of the chairman, seconded by Lord Armstrong, it was decided to sanction a contribution to charitable purposes in connection with the war of a sum not exceeding £200 during the ensuing half year. The accounts for the half year showed a surplus of receipts over expenses for the half year ended June 30, of £5,411, as compared with £5,824 in the corresponding half year. Including the balance brought forward of £731, there was a total of £6,142. After deducting interest on debentures, loans, etc., amounting to £1,012, the balance was £5,130. The directors recommended a dividend on the preference shares at the rate of 5 per cent. per annum ; on the ordinary shares at the rate of 3 per cent. per annum ; and they proposed to place to the credit of renewals and depreciation fund £1,200, to set aside for the reduction of registration and formation expenses £330, leaving £991 to be carried forward.

BRAZILIAN TRACTION, LIGHT AND POWER COMPANY.

THE LATE DR. PEARSON.

The second annual report of the directors of the Brazilian Traction, Light and Power Company (that for the year 1914) possesses a peculiar and melancholy interest from the fact that there is appended to it a report by the late Dr. F. S. Pearson, who was president of the company. He was one of the passengers who was lost when the steamship *Lusitania* was torpedoed by a German submarine in May last, and the report was drafted by him during the voyage. It was found in his pocket after the recovery of his body, and represents therefore his last work for the company.

The report of the directors states that during the year a large controlling interest was secured in the Companhia Rede Telephonica Bragantina, a telephone company carrying on business throughout the State of Sao Paulo. The investment was made without the necessity of providing cash for the purpose, by the issue of fully paid ordinary shares of this company. The company has also acquired an important interest in the Cia. Telephonica do Estado de Sao Paulo. The year 1914 has been one of general business depression in Brazil on account of local conditions. After the European war was declared, the conditions in Brazil became very serious, and the Government made various provisions to meet the monetary stringency, but great fluctuations were caused in exchange, the value of the milreis dropping as low as 10⅛d. during the second week in September. For several months it was practically impossible to remit money from Brazil for the payment of coupons and dividends. The board decided in October to remit its funds in coffee as a sound and safe procedure. As the Rio de Janeiro Tramway, Light and Power Company has under charter a fleet of steamers for carrying coal, etc., the board employed these steamers on their return journeys for freighting the coffee purchased in Brazil to the New York and European markets. Down to the end of the year the board purchased and shipped 278,400 bags of coffee, all of which has been sold in New York at an average net return of 13 54-64d. per milreis, which is materially in excess of the average rate of exchange during the period.

The result of the company's operations for the year have not been as satisfactory as was anticipated. With the large number of employees in factories thrown out of work, the earnings of the tramway systems in Rio de Janeiro and Sao Paulo were seriously affected, but the gross income of the combined companies in Brazilian currency has shown an increase. The following is a brief revenue statement for the year :—Revenue from securities owned and under contracts with subsidiary companies, $7,523,696 ; interest on advances to subsidiary companies, $535,117, making $8,058,813 ; general and legal expenses, administration charges and interest on loans, $392,281, leaving a surplus available for dividends, $7,666,532. Dividends Nos. 4, 5, 6 and 7, in 6 per cent. preference shares at 1½ per cent. each, $600,000 ; dividends Nos. 6, 7, 8 and 9 on common shares at 1½ per cent. each, $6,257,119, leaving a surplus carried to profit and loss, $809,412. After payment of the regular dividend of 6 per cent. per annum on the ordinary shares a credit balance of $3,822,410 has been carried forward in the profit and loss account.

The board express their poignant regret at the loss of Dr. Pearson, and testify to the esteem in which he was held for his attractive personal qualities as well as for his sagacity and ability in dealing with the large affairs entrusted to his care. Mr. Alex. Mackenzie has been elected president to fill the vacancy caused by Dr. Pearson's death.

DR. PEARSON'S REPORT.

The report which Dr. Pearson prepared during the fatal voyage of the *Lusitania* deals with the operations and finances of the subsidiary companies during 1914. In regard to the Rio de Janeiro Tramway, Light and Power Company, it says that the only department which failed to show an increase in gross earnings was the tramways, whose receipts fell off owing to business depression in the city. There are 236 miles of track, 525 electric passenger cars, 451 trailer cars, 69 electric freight cars, and 134 trailers. The miles run numbered 24,815,078, and the passengers totalled 192,103,635. Regarding the Sao Paulo Tramway, Light and Power Company, the industrial depression has been more marked. The tramway statistics include the following :—Miles of track, 143 ; electric passenger cars, 317 ; trailers, 57 ; electric freight cars, 55 ; trailers, 32 ; miles run, 9,496,091 ; passengers carried, 53,732,292 (against 56,776,702 in the previous year).

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Year Ended.	Electric Traction Inaugurated.	System.	Line open (single track). Mls. Chs.	Borrowing Powers.	Borrowing Powers Exercised.	Unexhausted Borrowing Powers.	Total Capital Expenditure.	Capital Expenditure per Mile of Single Track.	Loans Outstanding.	Loans Repaid and Sinking Fund.	Depreciation, Renewal and Reserve Funds.	Gross Receipts. Traffic.	Other.	Total.
Aberdeen	* May 31, 1915	Dec., 1899	E.	27 56	415,000	366,332	48,668	366,332	13,225	184,118	234,194	189,803	86,614	1,388	88,002
Accrington	Mar. 31, 1914	Aug., 1907	,,	10 53	181,925	133,875	48,050	134,734	12,636	113,870	20,864	16,581	29,843	350	30,193
Ashton-u-Lyne	Mar. 25, 1914	Aug., 1902	..	8 15	130,070	109,814	20,256	109,814	13,412	73,958	32,270	2,950	23,341	677	24,019
Ayr	May 15, 1914	Sept., 1901	,,	9 30	128,000	98,630	29,369	100,841	10,756	79,171	19,460	16,489	18,315	1,062	19,377
Birmingham	Mar. 31, 1914	Jan., 1904	,,	114 44	2,577,611	2,352,104	225,507	2,334,437	20,379	1,913,559	438,545	186,154	628,016	7,455	635,471
Blackburn	* Mar. 25, 1915	Mar., 1899	,,	24 63	408,174	342,474	65,700	336,258	13,566	354,600	191,985	3,718	65,158	3,144	68,302
Blackpool	Mar. 31, 1914	June, 1899	,,	(p)21 33	453,798	310,994	142,804	310,994	14,524	310,994	126,036	21,660	84,034	763	84,797
Bolton	* Mar. 31, 1915	Dec., 1899	,,	47 69	551,092	551,092	Nil	570,981	11,330	348,111	202,980	43,059	140,182	1,228	141,410
Bradford	Mar. 31, 1914	July, 1898	,,	(h)106 29	1,280,788	1,061,113	219,675	1,040,118	9,779	653,504	420,844	82,898	298,525	18,608	317,133
Brighton	* Mar. 31, 1915	Nov., 1901	,,	17 15	378,093	279,978	98,115	280,392	16,314	211,268	69,124	7,562	54,413	2,113	56,526
Burnley	Mar. 31, 1914	Dec., 1901	,,	22 18	388,052	325,999	62,053	232,501	10,461	179,136	64,381	39,684	88,050	266	88,316
Burton-on-Trent	Mar. 31, 1914	Aug., 1903	,,	10 50	108,632	104,562	4,070	106,275	10,121	49,239	55,323	10,134	15,010	1,497	16,507
Bury	* Mar. 31, 1915	June, 1903	,,	(b)36 10	407,800	284,745	123,055	293,237	12,826	254,832	55,416	33,960	68,740	276	69,016
Chester	Mar. 25, 1914	April, 1903	,,	6 35	92,991	82,380	10,611	82,934	12,883	68,477	14,121	4,282	12,793	480	13,273
Chesterfield	Mar. 31, 1914	Dec., 1904	,,	5 8	98,000	73,500	24,500	69,810	13,663	57,660	13,820	6,307	13,608	465	14,073
Colchester	* Mar. 31, 1915	July, 1904	,,	7 75	70,748	69,555	1,193	69,471	8,736	48,360	22,007	Nil.	13,413	380	13,793
Croydon	* Mar. 31, 1915	(q) Sept., 1901	,,	17 50	287,689	287,689	Nil	286,765	16,271	222,223	107,039	41,643	87,833	781	88,614
Darlington	Mar. 31, 1914	June, 1904	,,	8 71	107,500	77,832	29,668	77,786	8,752	56,178	23,338	6,806	12,976	261	13,237
Darwen	Mar. 31, 1914	Oct., 1900	,,	7 13	93,400	86,300	7,100	85,831	11,984	55,090	30,892	8,500	15,631	1,003	16,634
Derby	Mar. 31, 1914	July, 1904	,,	22 20	239,980	239,980	Nil	245,332	11,026	177,676	67,656	(l)32,356	E51,126	1,048	52,174
Doncaster	Mar 31, 1914	June, 1902	,,	12 58	...	...	...	107,921	8,481	94,700	16,581	1,442	22,890	318	23,208
Dundee	May 15, 1914	July, 1900	,,	28 32	(f)*	354,783	...	362,116	12,751	264,720	90,062	82,966	67,754	1,750	69,504
East Ham	Mar. 31, 1914	June, 1901	,,	14 5	190,643	190,242	401	191,654	13,127	140,457	65,478	3,453	54,079	836	54,915
Exeter	Mar. 31, 1914	April, 1905	,,	7 0	106,000	86,111	19,889	86,111	12,301	67,354	19,249	6,290	17,489	97	17,586
Gloucester	* Mar. 31, 1915	April, 1904	,,	15 1	191,000	144,333	46,667	147,783	9,846	104,965	22,901	1,000	16,693	1,114	17,807
Halifax	* Mar. 31, 1915	June, 1898	,,	55 39	449,263	417,466	31,797	420,185	7,570	283,249	129,670	36,442	111,792	1,378	113,170
Ilford	Mar. 31, 1914	Mar., 1903	,,	11 28	149,633	149,633	Nil	149,574	13,178	104,842	44,791	2,297	23,485	2,308	25,793
Ilkeston	Mar. 31, 1914	May, 1903	,,	3 56	64,214	47,000	17,214	47,833	13,436	31,462	16,422	...	6,915	171	7,086
Ipswich	Mar. 31, 1914	Nov., 1903	,,	14 70	116,471	114,300	2,171	115,676	7,776	96,912	18,447	11,994	22,964	862	23,826
Keighley	Mar. 31, 1913	Oct., 1904	,,	6 9	50,934	47,328	3,606	47,328	7,743	32,468	16,961	942	8,845	313	9,158
Kilmarnock	May 15, 1914	Dec., 1904	,,	5 47	65,000	52,795	12,205	53,281	9,536	47,250	8,707	5,298	9,088	265	9,353
Kirkcaldy	* May 15, 1915	Feb., 1903	,,	8 65	213,000	97,868	115,132	97,868	11,105	76,466	21,402	5,223	16,564	412	16,976
Lancaster	Mar. 31, 1914	Jan., 1903	,,	4 65	...	45,700	...	43,684	9,077	30,450	15,350	3,074	5,779	158	5,937
Leith	May 15, 1914	Aug., 1905	,,	17 73	275,000	238,000	37,000	236,877	13,211	179,350	58,650	3,045	36,555	1,170	37,725
Leyton	Mar. 31, 1914	Dec., 1906	,,	18 8	324,201	324,145	56	295,376	16,319	240,741	57,244	2,654	69,148	1,541	70,689
Lincoln	* Mar. 31, 1915	Nov., 1905	S.	2 77	98,519	44,947	53,572	44,987	15,185	40,226	12,529	(l) 692	6,435	117	6,552
Liverpool	Dec. 31, 1914	Nov., 1898	E.	124 0	2,622,786	2,057,850	564,936	2,062,391	16,741	1,168,685	1,177,949	366,545	684,026	13,050	697,076
Lowestoft	Sep. 30, 1914	July, 1903	,,	4 6	96,230	91,178	5,052	91,178	22,375	75,480	17,614	Nil	11,357	373	11,730
Maidstone	Mar. 31, 1914	July, 1904	,,	7 3	82,932	82,932	Nil	79,098	11,239	65,574	17,358	..	10,391	575	10,966
Manchester	* Mar. 31, 1915	June, 1901	,,	203 31	2,361,038	2,207,215	153,823	2,216,009	10,895	1,648,183	548,499	438,497	887,763	14,112	901,875
Nelson	Mar. 31, 1914	Feb., 1903	,,	3 69	38,000	37,885	115	37,885	9,808	29,145	8,740	...	10,801	52	10,853
Newport (Mon.)	Mar. 31, 1914	April, 1903	,,	14 28	219,250	196,250	23,000	194,983	13,588	159,734	45,350	4,055	40,151	1,039	41,190
Nottingham	* Mar. 31, 1915	Jan., 1901	,,	44 20	...	...	...	733,674	16,586	473,999	261,364	56,626	176,289	3,026	179,315
Oldham	Mar. 25, 1914	May, 1902	,,	28 6 (b) 8 31	509,723	442,047	67,676	444,565	15,835	311,148	133,167	8,455	114,481	1,689	116,170
Perth	May 15, 1913	Nov., 1905	,,	6 60	90,000	78,350	11,650	78,629	11,649	63,340	15,489	1,673	8,761	509	9,270
Plymouth	Mar. 31, 1914	Sept., 1899	,,	15 0	182,856	181,479	1,377	219,417	14,628	86,903	89,493	24,252	39,989	891	40,880
Pontypridd	Mar. 31, 1913	Mar., 1905	,,	8 48	136,019	135,919	100	137,148	15,946	109,757	26,052	Nil	21,580	313	21,893
Rawtenstall	* Mar. 31, 1915	May, 1909	,,	15 71	193,290	182,172	11,118	182,276	11,709	150,324	31,848	3,051	24,460	1,076	25,536
Rochdale	* Mar. 31, 1915	May, 1902	,,	(i)40 2	356,991	347,782	9,209	353,200	15,407	347,782	108,034	16,000	77,660	5,742	83,402
Rotherham	Mar. 31, 1914	Jan., 1903	,,	12 2	342,200	183,775	158,325	184,859	14,537	152,244	33,481	24,632	44,495	70	44,565
			R.T	...	...	...	...	...	...	...	...	...	5,757	...	5,767
Salford	Mar. 31, 1914	Oct., 1901	E.	75 64	1,050,666	724,469	326,197	723,923	9,554	532,821	191,648	28,492	272,758	54	272,812
Southampton	* Mar. 31, 1915	Jan., 1900	,,	18 54	280,452	260,699	19,753	259,834	13,913	158,729	99,470	14,251	68,042	2,996	71,038
Southend-on-Sea	Mar. 31, 1913	July, 1901	,,	11 49	130,000	129,961	39	143,808	12,384	116,940	12,784	3,045	34,453	465	34,918
Southport	Mar. 31, 1914	July, 1900	,,	(d) 10 63	294,000	197,730	94,270	196,178	9,921	150,250	47,480	442	18,391	455	18,846
South Shields	Mar. 31, 1914	Mar., 1906	,,	10 21	251,882	175,056	76,826	173,599	16,916	146,912	33,413	(l)26,881	37,744	586	38,330
Stalybridge, H., M., D.	* Mar 31, 1915	May, 1904	,,	27 57	325,270	280,990	44,280	279,778	10,096	209,387	71,603	1,211	37,490	130	37,620
Stockport	Mar. 31, 1914	Aug., 1901	,,	27 5	318,847	234,500	84,347	251,514	9,294	158,391	76,109	37,179	66,715	1,322	68,037
Sunderland	* Mar. 31, 1915	Aug., 1900	,,	20 28	308,699	303,211	5,488	306,766	15,074	161,996	132,265	45,044	75,229	386	75,615
Swindon	Mar. 31, 1914	Sept., 1904	,,	4 42	...	...	...	44,216	9,771	33,861	11,738	7,237	8,602	309	8,911
Wallasey	Mar. 31, 1914	Mar., 1902	,,	19 77	198,867	195,290	3,577	216,498	10,848	161,934	64,221	9,520	63,151	562	63,713
Walsall	Dec. 31, 1914	Dec., 1902	,,	19 44	188,145	188,100	45	182,926	9,357	154,044	63,649	34,960	33,311	778	34,089
Walthamstow	Mar 31, 1914	June, 1905	,,	13 30	198,000	194,000	4,000	188,192	14,070	171,716	21,781	1,940	38,590	718	39,308
Warrington	Mar. 31, 1914	April, 1902	,,	9 52	103,674	102,896	778	102,128	10,583	70,476	32,422	10,000	23,232	521	23,753
West Ham	* Mar. 31, 1915	Feb., 1904	,,	30 4	578,478	551,588	26,890	556,878	18,532	469,051	123,888	26,236	147,703	4,509	152,212
West Hartlepool	* Mar. 31, 1915	Feb., 1904	,,	8 63	85,494	80,330	5,164	81,731	9,301	76,501	3,682	4,614	19,011	494	19,505
Wigan	Mar. 31, 1914	April, 1901	,,	30 73	500,955	483,757	17,198	473,906	15,349	392,118	142,815	804	77,973	1,375	79,348
Wolverhampton	* Mar. 31, 1915	April, 1902	S.	21 40	279,733	268,185	11,548	292,361	13,596	209,497	71,812	53,987	54,593	730	55,323
Yarmouth (Gt.)	Mar. 31, 1914	June, 1902	E.	14 58	149,600	124,750	24,850	126,363	9,207	116,450	25,996	9,075	25,712	527	26,239
York	Mar. 31, 1914	Jan., 1910	,,	12 20	157,150	157,150	340	156,810	12,853	152,470	6,323	5,092	26,133	642	26,775

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	* Mar. 31, 1915	Nov., 1905	E.	98 54	1,528,146	1,381,200	136,946	1,455,506	14,702	1,343,000	257,730	96,622	266,249	3,988	270,237
Bexley	Mar. 31, 1914	Oct., 1903	,,	6 42	100,798	98,812	1,986	98,408	15,376	75,408	23,403	942	14,698	1,649	16,346
Birkenhead	Mar. 31, 1914	Feb., 1901	,,	24 7	376,398	369,528	6,870	371,097	15,406	239,201	130,267	22,655	67,725	4,300	72,025
Bournemouth	Mar. 31, 1914	July, 1902	,,	(e)29 62	471,850	432,440	39,410	443,006	19,821	286,385	146,054	18,409	104,353	616	104,969
Cardiff	Mar. 31, 1914	May, 1902	,,	31 66	830,382	787,292	43,090	786,510	24,714	514,059	273,232	104,002	141,519	24,681	166,200
Coventry	Mar. 31, 1914	Jan., 1912	,,	15 61	251,014	235,574	15,440	229,197	14,541	230,596	8,517	3,983	42,751	733	43,484
Glasgow	* May 31, 1915	Oct., 1898	,,	198 10 (b) 2 53	4,564,266	3,694,143	870,123	3,751,708	19,127	2,411,868	1,282,275	2,326,543	1,070,694	6,184	1,076,878
Huddersfield	* Mar. 31, 1914	Feb., 1901	,,	56 4	772,662	467,142	305,520	477,919	8,526	281,927	194,599	7,522	124,200	2,859	127,059
Hull	Mar. 31, 1915	July, 1899	,,	33 12	662,074	594,626	67,448	596,092	17,982	579,628	183,392	147,663	161,750	1,280	163,030
Leeds	* Mar. 31, 1915	Aug., 1897	,,	115 71	1,907,865	1,814,758	93,107	1,678,844	14,487	1,400,687	590,421	4,961	429,902	4,038	433,940
Leicester	Dec. 31, 1914	May, 1904	,,	37 0	1,006,946	818,073	138,290	828,953	22,404	674,936	147,944	91,843	149,664	20,571	170,235
London	Mar. 31, 1915	...	H.	9 67	(c)	(c)	(c)	...	...	...	...	...	10,261	540	10,801
		May, 1913	C.E	274 35				13,744,806	...	9,836,187	3,786,403	565,095	2,323,130	65,916	2,389,046
N'castle-on-Tyne	Mar. 31, 1914	Dec., 1901	E.	62 72	1,522,010	1,277,747	244,263	1,284,380	20,428	929,766	428,119	94,337	251,024	10,177	261,201
Northampton	Mar. 31, 1914	July, 1904	,,	9 16	239,800	127,255	112,545	126,431	13,742	87,022	40,501	11,834	28,527	812	29,339
Portsmouth	* Mar. 31, 1914	Sep., 1901	,,	34 48	708,619	708,619	Nil	731,174	21,132	423,103	285,516	81,715	121,909	2,082	123,991
Preston	Mar. 31, 1914	June, 1904	,,	17 16	224,102	187,269	36,833	187,269	10,888	117,315	47,130	39,392	45,618	328	45,946
Reading	Mar. 31, 1914	July, 1903	,,	13 14	235,000	234,000	1,000	230,763	17,515	162,634	68,159	18,371	35,282	1,043	36,325
Sheffield	* Mar. 25, 1915	Sep., 1899	,,	79 8	1,782,471	1,484,400	298,071	1,558,246	19,703	1,122,482	512,567	34,450	391,535	2,996	394,531
Wellington, N.Z.	Mar. 31, 1914	...	,,	31 55	496,423	496,423	...	628,151	19,821	496,423	46,836	120,191	157,096	1,161	158,257

C—Electric conduit system. E—Electric trolley system. H—Horse lines RT—Railless trolley system. S—Surface contact system.
(b) Includes leased lines. (c) Conferred by Annual Money Act, which limits amount for each financial year. Powers not exercised are lapsed.
(d) Not including 8 m. 78 ch. leased lines. (e) Includes 7 mi. 34 chs. leased lines. (f) Unlimited. (h) Includes 1½ miles railless trolley route. (i) 17 mi. 8 chn. single track leased.
(k) Not including 10 miles 3 chains single track lines leased. (l) Including Insurance. (p) Including leased lines. (q) Corporation working commenced June, 1906.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Working Expenses.					Gross Profit on Working.	Additions to Gross Profit	Deductions from Gross Profit.					Net Surplus + or Deficit −
	Traffic.	General.	Repairs & Maintenance.	Power.	Total.			Interest.	Sinking Fund.	Income Tax.	Depreciation & Renewal	Sundries.	Total.	
Aberdeen	23,291	12,148	7,920	8,166	51,525	36,477	...	4,789	5,179	...	13,840	(i) 1,669	25,477	+ 11,000
Accrington	7,570	2,792	2,268	4,880	17,510	12,683	...	3,969	3,783	198	3,100	65	11,115	+ 1,568
Ashton-under-Lyne	5,149	1,682	3,053	3,372	13,256	10,763	...	2,590	3,760	477	800	39	7,666	+ 3,097
Ayr	4,206	2,093	1,905	2,457	10,661	8,716	...	(h) 2,558	1,744	164	2,503	606	7,575	+ 1,141
Birmingham	183,119	59,947	88,698	113,743	445,507	189,964	8,487	68,478	53,804	...	...	197	122,479	+ 75,972
Blackburn	16,859	6,197	14,451	9,421	46,928	21,374	287	(h) 4,388	15,450	251	1,572	...	21,661	...
Blackpool	16,643	6,851	9,719	10,273	43,486	41,311	...	(h) 9,429	7,329	...	10,000	...	26,758	+ 14,553
Bolton	30,044	(q) 9,486	15,912	20,689	76,131	65,279	857	(h) 10,525	17,520	1,713	18,339	(i) 981	49,078	+ 17,058
Bradford	92,305	29,243	58,991	50,611	231,150	85,983	3,877	20,443	31,822	3,888	11,454	5,053	72,660	+ 17,200
Brighton	14,152	(i) 6,759	13,690	8,384	42,985	13,541	55	7,661	5,917	...	...	...	13,578	+ 18
Burnley	23,284	7,571	11,998	20,096	62,949	25,367	...	6,939	7,728	1,072	...	(f) 1,941	17,680	+ 7,687
Burton-on-Trent	5,442	1,502	2,562	3,154	12,660	3,847	(q) 1,524	1,364	1,344	...	1,500	...	4,208	+ 1,163
Bury	16,129	4,971	7,162	7,504	35,766	33,250	303	(h) 7,037	6,026	825	2,472	(w) 11,193	27,553	+ 6,000
Chester	3,290	1,534	1,208	2,096	8,128	5,145	158	(h) 2,754	1,018	..	...	...	3,772	+ 1,531
Chesterfield	3,214	1,368	2,936	2,192	9,710	4,363	269	2,275	1,900	...	...	...	4,175	+ 457
Colchester	3,045	1,372	2,370	2,783	9,570	4,223	28	(h) 1,986	2,496	...	...	(i) 172	4,654	− 403
Croydon	31,319	(i) 9,151	14,128	17,684	72,282	16,332	749	7,889	7,415	1,587	...	...	16,891	+ 190
Darlington	4,305	812	1,995	2,012	9,124	4,113	101	(h) 1,944	1,996	102	469	...	4,511	− 297
Darwen	3,980	1,018	3,287	2,569	10,854	5,780	156	2,247	2,190	...	1,050	...	5,487	+ 449
Derby	E 17,320 H 540	2,906 ...	5,499 81	8,610 ...	34,335 621	17,839 def. 173	239	6,236	3,464	...	5,536	(l) 185	15,421	+ 2,657
Doncaster	4,969	1,342	6,550	4,166	17,027	6,181	16	2,935	1,840	138	572	58	5,543	+ 654
Dundee	17,495	5,964	9,477	10,502	43,438	26,066	...	8,742	6,400	211	9,701	...	25,054	+ 1,012
East Ham	18,739	6,802	12,067	10,521	48,129	6,786	...	(h) 5,570	6,882	...	...	573	13,025	− 6,239
Exeter	4,888	1,373	1,483	3,827	11,571	6,015	...	(h) 2,305	1,885	101	...	...	4,291	+ 1,724
Gloucester	7,250	1,643	2,975	1,836	13,704	4,103	...	(h) 5,362	1,881	370	...	...	7,613	− 3,510
Halifax	30,501	7,877	13,529	21,597	73,504	39,321	345	10,424	12,106	...	(y) 925	(i) 2,632	23,455	+ 16,211
Ilford	9,916	2,431	3,740	4,791	20,878	4,915	557	3,969	5,070	...	...	...	9,039	− 3,567
Ilkeston	2,262	789	1,378	1,460	5,889	1,197	160	1,450	1,532	90	...	96	3,168	− 1,811
Ipswich	8,538	2,250	5,578	3,522	19,888	3,938	...	(h) 3,624	2,142	...	...	...	5,766	− 1,828
Keighley	2,692	768	899	1,612	5,971	3,187	179	1,116	1,881	...	...	(n) 369	3,366	...
Kilmarnock	3,195	746	1,327	1,717	6,985	2,368	...	1,628	1,252	...	1,160	...	4,040	− 1,672
Kirkcaldy	4,811	1,416	2,312	2,912	11,451	5,525	68	2,604	2,411	...	409	136	5,560	+ 33
Lancaster	2,290	522	841	1,594	5,247	690	52	1,158	1,511	...	...	...	2,669	− 1,927
Leith	9,742	3,131	5,080	3,920	21,873	15,852	242	(h) 6,211	7,850	...	2,274	67	16,402	− 308
Leyton	(p) 22,360	8,611	13,711	12,923	57,605	13,084	133	10,007	8,461	...	...	202	18,670	− 5,453
Lincoln	1,446	656	967	872	3,941	2,611	47	1,529	1,071	...	...	(i) 6	2,606	+ 52
Liverpool	192,352	69,830	83,100	123,527	468,809	228,267	25,231	50,082	63,726	...	(d) 34,821	(e) 4,869	153,498	+ 100,000
Lowestoft	3,405	655	1,552	2,323	7,935	3,795	..	2,441	2,251	...	...	...	4,692	− 897
Maidstone	2,609	1,062	1,686	1,934	7,291	3,675	57	2,470	1,969	...	...	114	4,553	− 821
Manchester	273,002	(i) 117,573	85,280	128,350	604,205	297,670	14,615	(h) 58,243	57,599	13,790	48,584	(c) 34,069	212,285	+ 100,000
Nelson	2,537	684	1,525	2,123	6,869	3,984	...	978	1,026	...	...	...	2,004	+ 1,980
Newport (Mon.)	10,513	4,240	13,070	6,670	34,493	6,697	925	5,850	4,231	...	...	158	10,239	− 2,617
Nottingham	48,272	14,674	17,408	30,692	111,046	68,269	...	16,444	21,121	...	...	(i) 2,040	39,605	+ 28,664
Oldham	26,908	8,585	22,246	20,564	78,303	37,867	1,317	15,559	11,718	1,352	...	(g) 5,654	34,283	+ 4,901
Perth	3,182	698	418	1,252	5,550	3,720	50	1,523	1,632	3	612	...	3,770	...
Plymouth	8,430	3,896	4,514	8,026	24,866	16,014	1,257	4,282	3,141	690	5,121	...	13,234	+ 4,037
Pontypridd	5,017	1,395	5,476	3,196	15,084	6,809	1,754	(h) 4,009	4,160	...	...	39	8,208	+ 355
Rawtenstall	6,126	2,446	3,187	4,273	16,032	9,504	85	5,483	6,493	...	...	...	11,976	− 2,387
Rochdale	19,308	5,063	10,984	11,537	46,892	36,510	1,636	11,478	9,594	2,038	...	(i) (x) 10,752	33,862	+ 4,284
Rotherham	E 10,374 RT 1,310	3,084 409	7,888 1,434	9,918 658	31,264 3,811	13,301 1,946	209 31	5,008 400	3,465 568	... ...	... ...	... ...	8,473 968	+ 5,037 + 1,009
Salford	79,460	23,804	25,203	50,303	178,770	94,042	5,044	(h) 17,392	22,470	2,760	5,674	(k) 28,790	77,086	+ 22,000
Southampton	21,466	(i) 6,862	9,433	12,545	50,306	20,732	(t) 6,757	7,564	7,557	952	5,000	...	21,073	+ 6,416
Southend-on-Sea	8,046	2,260	3,534	6,187	20,027	14,891	4,228	(h) 3,834	1,753	...	4,017	...	9,605	+ 9,514
Southport	4,754	2,126	3,103	2,999	12,982	5,864	6,379	6,516	5,018	...	2,144	...	13,678	− 1,435
South Shields	8,838	3,715	3,633	6,399	22,585	15,745	265	(h) 5,333	3,570	...	...	...	8,903	+ 7,107
Staly'dge, H., M., D.	12,818	(i) 5,022	7,448	5,761	32,049	5,571	...	7,485	7,786	...	400	397	16,068	− 10,497
Stockport	14,828	4,583	10,045	5,964	35,420	32,617	1,170	5,432	8,909	1,163	2,369	(j) 3,414	21,287	+ 12,500
Sunderland	19,807	5,608	4,867	11,267	41,549	34,066	265	(h) 6,464	10,374	1,218	10,875	400	29,331	+ 5,000
Swindon	2,854	828	1,534	1,850	7,066	1,845	45	1,215	1,422	...	...	...	2,637	− 747
Wallasey	17,686	4,792	6,512	11,500	40,490	23,223	92	5,603	4,885	...	...	634	11,122	+ 12,193
Walsall	8,510	3,326	4,315	5,670	21,821	12,268	1,339	4,962	3,975	551	640	...	10,128	+ 3,479
Walthamstow	14,821	3,234	7,416	8,568	34,039	5,269	301	(h) 6,396	3,265	...	3,645	..	13,306	− 7,736
Warrington	5,999	1,834	3,973	3,411	15,217	8,536	537	2,481	3,353	...	...	...	5,834	+ 3,239
West Ham	52,659	†14,531	33,326	19,420	119,936	32,276	243	18,875	12,679	...	692	...	32,246	+ 273
West Hartlepool	4,791	1,586	2,956	2,241	11,574	7,931	3	2,569	1,847	...	..	(f) 500	4,916	+ 3,018
Wigan	16,604	5,226	11,643	11,016	44,489	34,859	308	14,197	12,561	...	...	(e) 3,719	30,477	+ 4,690
Wolverhampton	13,031	(i) 6,239	8,594	7,202	35,066	20,257	(x) 2,535	7,760	5,669	203	5,416	...	19,048	+ 3,744
Yarmouth (Gt.)	7,756	1,849	3,052	4,951	17,608	8,631	75	(h) 4,065	2,826	...	1,815	...	8,706	...
York	8,713	2,028	1,936	5,259	17,936	8,839	...	(h) 4,609	1,706	...	...	...	6,315	+ 2,524

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	75,752	17,245	35,294	28,622	156,913	113,325	...	48,342	31,277	1,478	17,879	2,164	101,140	+ 12,185
Bexley	3,282	1,382	*3,554	828	(s) 11,630	4,716	...	2,794	2,509	...	324	..	5,627	− 911
Birkenhead	17,015	5,374	11,759	10,744	44,892	27,133	83	(h) 11,577	9,499	373	5,712	55	27,216	...
Bournemouth	24,154	8,350	10,307	16,200	59,011	45,958	2,550	(h) 10,265	15,255	...	12,871	(e) 8,117	46,508	+ 2,000
Cardiff	44,037	11,121	18,146	26,260	99,564	66,636	2,592	23,941	23,014	2,835	6,946	...	56,736	+ 12,492
Coventry	12,861	4,471	7,945	3,839	29,116	14,368	478	8,506	5,230	...	277	414	14,427	+ 419
Glasgow	345,625	(i) 193,837	144,530	51,995	735,987	340,891	65,826	78,797	105,492	22,790	172,310	14,377	393,766	+ 12,951
Huddersfield	33,571	(i) 7,911	20,449	12,047	73,978	53,081	...	(h) 12,536	13,061	2,274	15,575	1,235	44,681	+ 8,400
Hull	(i) 58,137	12,634	31,909	11,622	114,302	48,728	...	16,578	13,883	576	3,117	...	34,154	+ 14,574
Leeds	115,601	40,347	43,609	28,577	228,134	205,805	7,837	47,174	57,773	7,356	11,928	(i) 7,844	132,075	+ 81,567
Leicester	59,052	11,397	22,836	25,322	118,607	51,628	1,660	24,218	13,764	2,801	10,741	1,284	52,808	+ 480
London	H. 4,737 E. 793,481	1,859 (r) 276,574	3,878 364,064	(m) 5,854 250,124	16,328 1,684,243	def. 5,527 704,803	... 47,425	330,301	405,605	32,102	1,541	(l) 15,851	785,400	− 33,172
N'castle-on-Tyne	71,892	25,519	27,150	22,991	147,552	113,649	4,086	(h) 31,257	41,450	3,618	...	2,805	79,130	+ 38,605
Northampton	7,881	3,169	2,806	4,958	18,814	10,525	506	(h) 3,322	4,422	309	195	(b) 1,083	9,331	+ 1,700
Portsmouth	31,414	(i) 13,293	8,371	5,580	58,658	65,333	(a) 11,483	21,643	18,455	1,941	11,677	532	54,248	+ 22,568
Preston	12,350	4,989	9,252	2,995	29,586	16,360	...	3,625	5,038	..	...	1,356	10,019	+ 6,341
Reading	8,635	3,661	4,086	3,597	19,979	16,346	...	6,716	5,062	149	...	...	11,927	+ 4,419
Sheffield	120,296	(i) 31,784	45,385	49,365	246,830	147,701	2,056	31,747	42,504	5,567	30,017	8,014	117,849	+ 31,908
Wellington, N.Z.	57,973	7,775	21,918	17,947	105,613	52,644	2,091	19,865	4,757	...	14,682	...	39,304	+ 15,431

(a) Includes £10,703 balance forward from previous year. (b) Includes £311 loss on omnibus account. (c) Includes £1,611 insurance fund. (d) Includes reserve. (e) Includes rents for leased lines. (f) Rent of leased lines. (g) Rent of lines and deficit on motor omnibus account. (h) Including income tax. (i) Includes Army Service Allowance. (j) Includes £692 deficit on railless traction. (k) Includes rents of lines. (l) Including loss on horse traction. (m) Horsing expenses. (n) Transferred to motor omnibus capital account. (o) Includes £1,337 through-running contributions. (p) Includes £407 horse account. (q) Includes National Insurance. (r) Including special charges, £6,053. (s) Includes £2,584 through-running contributions to L.C.C. (t) Includes balance forward from previous year. (w) Amount apportioned to leased lines. (x) Includes £1,554 profit on motor char-a-banc. (y) Parliamentary Expenses. (z) Includes £6,519 rent of leased lines. * Includes £1,913 spent on renewals. † Under a resolution of the Council, the allowances to employees serving with the Forces, amounting to £6,031, are defrayed out of rates and therefor not included in these accounts. ‡ £2,950 profit from 3 months' working.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Appropriation of Net Surplus.			Receipts per Car Mile.		Operating Expenses per Car Mile.					Percentage of Operating Expenses to Total Revenue.	Average Operating Expenses per Car Mile (excludi'g Power Cost).	Board of Trade Units.		
	Carried Forward.	Reserve.	Contribution to Rates or Municip'l Funds.	Average Total per Car Mile. d.	Average Traffic per Car Mile. d.	Traffic. d.	General. d.	Repairs and Maintenance. d.	Power. (Price paid) d.	Total. d.	%	d.	Units.	Cost per Unit. d.	Units used per car mile.
Aberdeen ...	...	7,590	3,410	11·06	10·89	2·93	1·53	·99	1·03	6·48	58·54	5·45	2,317,204	·845	1·027
Accrington ...	...	...	1,568	12·64	12·49	3·17	1·18	·94	2·04	7·33	57·99	5·29	949,054	1·23	1·65
Ashton-u-Lyne	47	...	3,050	12·4197	12·0692	2·6622	·8695	1·5788	1·7434	6·8539	55·19	5·1105	640,413	1·25	1·38
Ayr...	...	1,141	...	10·45	9·88	2·26	1·12	1·02	1·32	5·75	55	4·42	421,844	1·39	·94
Birmingham ...	...	31,000	44,972	10·689	10·564	3·080	1·009	1·492	1·913	7·494	70	5·581	24,257,823	1·125	1·70
Blackburn ...	...	...	...	13·81	13·71	3·40	1·25	2·92	1·91	9·48	68·70	7·57	1,739,274	1·3	1·54
Blackpool ...	...	2,553	12,000	18·91	18·74	3·71	1·52	2·17	2·29	9·69	51·28	7·40	1,506,323	1·63	1·40
Bolton	58	...	17,000	11·758	11·656	2·498	·788	1·323	1·721	6·330	53·836	4·610	4,514,010	1·1	1·56
Bradford	...	...	17,200	12·166	11·486	3·204	1·051	2·173	1·948	8·376	73·138	6·428	12,041,279	1	1·924
Brighton	18	...	...	12·240	11·782	3·064	1·464	2·964	1·816	9·308	72·79	7·10	1,676,770	1·2	1·51
Burnley	...	...	7,687	12·079	12·043	3·185	1·035	1·640	2·749	8·609	71·37	5·86	3,894,011	1·24	2·22
Burton-on-Trent	1,163	...	...	9·02	8·28	2·97	·82	1·40	1·72	6·91	76·7	5·08	545,672	1·39	1·08
Bury	...	(k)1,000	5,000	10·26	10·22	2·399	·776	1·253	1·268	5·696	51·82	4·428	2,045,692	1·25	1·26
Chester	...	1,531	...	9·17	8·84	2·27	1·06	·83	1·45	5·61	61	4·17	378,158	1·33	1·08
Chesterfield ...	...	457	...	11·1	10·8	2·54	1·08	2·31	1·73	7·66	68·9	5·93	420,824	1·25	1·38
Colchester ...	...	...	...	9·942	9·668	2·194	·989	1·709	2·006	6·898	69·24	4·892	445,214	1·5	1·34
Croydon	...	190	...	7·593	7·526	2·683	·784	1·211	1·516	6·194	78·68	4·493	3,000,308	1·416	1·071
Darlington ...	...	...	...	8·230	8·068	2·676	·505	1·241	1·251	5·673	68·93	4·422	482,791	1	1·25
Darwen	448	...	...	14·96	14·09	3·20	·92	2·96	2·31	9·39	65·25	7·08	469,939	1·312	1·77
Derby	(n) 75	...	...	E. 10·358 H. 6·077	10·150 5·821	3·438 7·325	·577 ...	1·092 1·099	1·709 ...	6·816 8·424	65·8 138·6	5·107 ...	1,425,112 ...	1·45 ...	1·179 ...
Doncaster ...	...	654	...	10·52	10·37	2·24	·61	2·97	1·90	7·72	73·1	5·82	799,965	1·25	1·51
Dundee	...	12	1,000	12·018	11·716	3·026	1·031	1·639	1·815	7·511	62·49	5·696	2,520,470	1	1·815
East Ham ...	...	...	...	8·73	8·59	2·98	1·08	1·92	1·67	7·65	87·60	5·98	2,385,535	1·062	1·58
Exeter	...	1,724	...	9·456	9·404	2·628	·738	·797	2·059	6·222	65·8	4·163	565,247	1·625	1·27
Gloucester ...	...	...	...	6·84	6·41	2·78	·63	1·14	·71	5·26	77	4·55	470,336	1	·70
Halifax	...	(r) 7,483	(s)6,171	11·657	11·514	3·141	·812	1·393	2·225	7·571	65	5·35	4,607,293	1·125	1·98
Ilford	...	...	...	6·891	6·768	2·862	·688	1·048	1·278	5·877	80·9	4·598	1,079,384	1·065	1·175
Ilkeston	...	...	...	7·04	6·87	2·3	·8	1·3	1·4	5·8	83	4·4	372,200	1	1·54
Ipswich	...	...	...	8·552	8·242	3·065	·807	2·002	1·265	7·139	83·47	5·874	676,189	1·25	1·011
Keighley	...	...	...	9·064	8·754	2·664	·761	·890	1·595	5·910	65	4·315	254,636	1·5	1·05
Kilmarnock ...	...	...	...	7·539	7·326	2·57	·61	1·07	1·38	5·63	74·6	4·246	329,577	1·25	1·14
Kirkcaldy ...	33	...	...	9·085	8·864	2·574	·758	1·238	1·558	6·128	67·4	4·57	698,804	1	1·558
Lancaster ...	...	...	...	8·23	7·94	3·14	·71	1·16	2·19	7·20	88	5·02	225,094	1·7	1·29
Leith	...	...	...	9·54	9·24	2·46	·79	1·29	·99	5·53	57·98	4·54	939,737	1·001	·99
Leyton	...	...	...	9·355	9·151	(c) 2·959	1·140	1·815	1·710	7·624	81·338	5·914	3,043,900	1·019	1·678
Lincoln	52	...	...	10·59	10·40	2·34	1·06	1·56	1·41	6·37	60·2	4·96	173,895	1·25	1·128
Liverpool ...	...	...	100,000	12·25	12·02	3·380	1·227	1·460	2·171	8·238	65·6	6·067	26,007,694	1·14	1·9
Lowestoft ...	...	...	...	9·1	8·8	2·60	·5	1·2	1·8	6·1	67·64	4·3	318,601	1·75	1·03
Maidstone ...	...	...	...	8·51	8·06	2·02	·81	1·34	1·48	5·65	70·07	4·17	371,290	1·25	1·2
Manchester ...	...	...	100,000	11·300	11·123	3·420	1·473	1·069	1·608	7·570	63·47	5·962	29,922,197	1·029	1·562
Nelson	1,980	...	...	12·85	12·78	3·00	·81	1·81	2·51	8·13	63	5·62	255,621	2	1·26
Newport (Mon.)...	...	...	...	10·207	9·950	2·605	1·056	3·239	1·653	8·553	83·74	6·913	1,187,262	1·29	1·23
Nottingham ...	...	6,164	22,500	11·35	11·16	3·06	·93	1·10	1·94	7·03	62·78	5·09	5,806,688	1·25	1·53
Oldham	...	4,901	...	13·422	13·228	3·109	·992	2·570	2·376	9·047	67·40	6·671	3,291,607	1·5	1·585
Perth	...	...	...	8·79	8·31	3·02	·66	·39	1·19	5·26	59	4·07	277,474	1·08	1·09
Plymouth ...	...	...	4,037	12·066	11·450	2·42	1·11	1·29	2·298	7·12	60·83	4·82	1,159,069	1·66	1·38
Pontypridd ...	355	...	...	12·16	11·99	2·78	·78	3·04	1·78	8·38	68·89	6·6	613,719	1·25	1·42
Rawtenstall ...	...	...	...	10·11	9·699	2·40	·99	1·27	1·69	6·35	62·57	4·66	833,714	1·23	1·37
Rochdale... ...	4,284	...	...	11·292	11·134	2·611	·682	1·524	1·654	6·471	56·2	4·817	2,836,062	1·006	1·694
Rotherham ...	E. ... R.T....	4,287 1,009	750 ...	12·54 10·74	12·52 10·74	2·92 2·44	·87 ·76	2·22 2·68	2·79 1·23	8·80 7·11	70·15 66·20	6·01 5·88	1,731,184 120,303	1·375 1·375	2·03 1·07
Salford	...	...	22,000	10·501	10·499	3·059	·916	·970	1·936	6·881	65	4·945	9,812,392	1·23	1·606
Southampton ...	1,282	...	5,134	...	...	...	...	...	...	...	...	...	...	...	...
Southend-on-Sea	2,514	1,000	6,000	13·14	12·97	3·03	·85	1·33	2·33	7·54	57·35	5·21	848,538	1·75	1·33
Southport ...	...	...	...	9·763	9·528	2·462	1·101	1·607	1·554	6·725	68·8	5·171	468,554	1·5	1·011
South Shields ...	(d) 500	4,907	1,700	10·244	10·087	2·362	·993	·971	1·710	6·036	58·92	4·326	1,105,203	1·388	1·231
Stalybridge, &c.	...	...	...	8·084	8·056	2·755	1·079	1·600	1·453	6·887	83·15	5·269	1,803,063	·9	1·614
Stockport ...		250	12,250	10·958	10·745	2·388	·738	1·618	·961	5·705	47·94	4·744	...	...	...
Sunderland ...		...	5,000	12·210	12·148	3·198	·905	·786	1·820	6·709	54·75	4·8	1,802,694	1·5	1·21
Swindon	...	...	...	9·62	9·24	3·06	·89	1·65	1·99	7·59	79·29	5·60	277,568	1·6	1·24
Wallasey ...	1,443	3,000	7,750	11·844	11·739	3·287	·891	1·211	2·138	7·527	63·5	5·38	1,971,378	1·4	1·52
Walsall	2,479	...	1,000	11·353	11·094	2·834	1·108	1·437	1·888	7·267	64·012	5·379	838,649	1·68	1·164
Walthamstow ...	...	...	...	8·09	7·94	3·05	·66	1·53	1·76	7·00	86·6	5·24	1,495,460	1·375	1·28
Warrington ...	739	...	2,500	12·521	12·246	3·161	·966	2·096	1·798	8·021	68·273	6·223	545,817	1·5	1·199
West Ham ...	...	273	...	9·713	9·427	3·359	1·314	2·127	1·239	8·039	78	6·41	6,306,731	·75	1·66
West Hartlepool	...	3,018	...	9·77	9·52	2·39	·79	1·49	1·13	5·80	59	4·67	680,972	·78	1·42
Wigan	4,690	...	...	12·77	12·46	2·655	·836	1·862	1·761	7·11	56·07	5·35	2,216,740	1 5/16	1·476
Wolverhampton	...	...	3,744	11·239	11·091	2·648	1·267	1·746	1·463	7·124	62·5	5·661	1,712,796	1	1·45
Yarmouth (Gt.)...	...	...	...	8·738	8·563	2·583	·616	1·016	1·649	5·864	68·48	4·215	758,296	1·56	1·052
York	...	2,524	...	9·08	8·86	2·95	·69	·66	1·78	6·08	67	4·30	1,009,827	1·25	1·43

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

									*					Works Cost.	
Belfast	...	...	12,185	10·08	9·93	2·83	·64	1·32	1·07	5·86	58·07	4·79	10,439,797	·658	1·39
Bexley	...	..	...	11·13	12·3	2·53	·85	2·82	·68	6·88	71·1	6·20	487,110	·827	1·66
Birkenhead ...	...	...	...	12·643	12·496	3·140	·991	2·170	1·336	7·637	60·33	6·30	2,672,599	·65	2·054
Bournemouth ...	...	2,000	...	12·83	12·76	2·95	1·02	1·26	(b) 1·99	7·22	56·21	5·23	3,245,277	·67	1·65
Cardiff	845	2,047	9,600	11·65	11·45	3·563	·900	1·468	·850	6·781	60	5·931	5,073,942	·488	1·71
Coventry ...	419	...	...	9·271	9·115	2·742	·953	1·694	·819	6·208	66·9	5·389	1,652,029	·544	1·47
Glasgow	...	...	12,951	10·674	10·612	3·426	1·922	1·432	·515	7·295	59·87	6·266	33,848,947	·366	1·40
Huddersfield ...	8,400	...	...	11·05	10·79	2·92	·70	1·78	1·04	6·44	58·22	5·40	5,398,258	·49	1·93
Hull	...	4,574	10,000	8·61	8·53	2·87	·66	1·68	·61	5·82	67·58	5·26	6,352,263	·44	1·40
Leeds	...	...	81,567	10·936	10·834	2·914	1·016	1·099	·720	5·749	52·57	5·029	18,862,847	·668	1·918
Leicester... ...	...	...	480	9·875	8·682	3·425	·661	1·325	1·469	6·880	69	5·411	7,540,856	·420	1·82
London	...	...	...	E. 9·77 H. 9·51	9·50 9·03	3·24 4·17	1·14 1·64	1·49 3·41	1·02 5·15	6·89 14·37	68·73 151·17	5·69 14·37	152,666,477 ...	·615 ...	2·60 ...
N'castle-on-Tyne	...	25,135	13,470	11·709	11·253	3·222	1·144	1·217	1·031	6·614	54·96	5·583	10,231,454	·421	1·922
Northampton ...	...	1,200	500	10·69	10·39	2·87	1·15	1·03	1·80	6·85	64	5·05	966,282	1·23	1·47
Portsmouth ...	6,568	(i) 6,000	10,000	12·201	11·997	3·092	1·308	·824	·549	5·773	45·88	5·050	3,272,089	·483	1·139
Preston	...	5,041	1,300	10·75	10·54	2·890	1·168	2·164	·700	6·922	64·40	6·222	1,765,250	·407	1·49
Reading	...	2,529	1,890	9·261	8·996	2·201	·933	1·042	·917	5·093	55	4·18	1,170,173	·737	1·12
Sheffield	...	9,032	22,876	10·747	10·666	3·277	·866	1·236	1·345	6·724	61·116	5·379	18,329,775	646	1·979
Wellington, N.Z.	15,431	...	...	16·309	16·189	5·974	·801	2·259	1·850	10·884	65·86	9·034	4,769,149	·906	2·05

* The figures given under "Power" in Table II. include actual works costs only. H—Horse lines. E—Electric trolley system. (b) Including current supplied by Bournemouth and Poole Supply Company. (c) Horse account ·054d. (d) Accident, insurance, and compensation fund. (f) Insurance fund. (i) Including Insurance. (k) Insurance. (n) Remainder expended in paying capital expenditure not borrowed. (r) Renewals Fund. (s) Military Allowances, &c., £2,557. (t) Amounts for 15 months.

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RECORDS OF ELECTRIC TRAMWAY ACCOUNTS

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Population Served.	Car Mileage.	Passengers Carried.	Traffic Records. Passengers Carried per Car Mile.	Average Fare per Passenger. d.	Average Journeys per Head of Popular'n per Annum.	Average Car Miles per Day per Car.	Traffic Revenue per Mile of Single Track. £	Average Traffic Revenue per Annum per Head of Popular'n Served. d.	Operating Expenses per Passenger. d.	Average Distance of 1d. Fare. Miles.	Average Fare Charged per Mile. d.	Average Speed per Hour. Miles.	Average Total Car Hours per Day.	Average Number of Cars in Use Daily.	Number of Cars in Stock.
Aberdeen ...	165,000	1,909,009	24,048,816	12·59	·86	145·8	90	3,121	10·6	·514	...	·57	7·6	812	63	83
Accrington ...	45,525	573,536	4,938,979	8·72	1·377	109·8	105	3,033	13·1	·84	1·07	·929	7·5	250	18	27
Ashton-u-L.	50,000	464,160	5,053,701	10·888	·648	173·09	106	2,851	9/4	·368	1·223	·81	8	190	12	25
Ayr	33,000	444,802	4,238,494	9·52	1·04	128	102	1,953	11·1	·606	1·25	·75	8	168	12	22
Birmingham	868,430	14,268,24	146,930,986	10·29	1·03	169	79·77	5,482	14·5	·904	2·	·427	7·87	10·16	500	550
Blackburn ...	200,000	1,121,769	12,223,569	10·89	1·28	61·12	105	2,528	6·6	·902	1·25	·76	7·50	434	31	61
Blackpool ...	67,500	1,075,943	14,289,802	13	1·41	211·7	86·7	4,524	24·9	·73	...	...	8	...	34	78
Bolton ...	221,000	2,886,180	31,370,166	10·86	1·066	141·49	124·07	2,920	12·8	·582	1·553	·633	7·25	980	70	112
Bradford ...	370,000	6,255,878	67,675,166	10·816	1·058	182	113	2,792	16·2	·819	1·67	·531	7·3	2,340·5	151	248
Brighton ...	133,936	1,108,352	11,837,828	11	1·10	88·38	76·08	3,165	8/1½	·83	1·27	·787	6·41	512	32	53
Burnley ...	175,000	1,754,811	17,668,834	10·07	1·18	101	120	3,971	10/1	·85	1·25	·83	7	874	46	67
Burton ...	48,000	439,248	3,339,184	7·60	1·058	70	...	1,782	6·3	·91	1·505	·58	7·5	...	...	20
Bury	128,202	1,613,357	15,513,264	9	1·07	121·47	99·73	1,904	10 9	·554	1·30	·77	8·54	...	...	54
Chester ...	39,028	347,260	3,217,899	9·26	·95	82·45	95	1,987	6/7	·606	1·27	·8	7	150·6	10·04	18
Chesterfield	50,000	304,376	2,950,774	9·7	1·1	76	122	2,668	5·5	·78	1·38	·75	7·33	126	7	17
Colchester ...	65,000	332,963	2,434,786	7·31	1·32	37·46	86·80	1,689	4/1	·94	·85	·96	6·77	147·14	10·51	18
Croydon ...	181,956	2,803,883	19,847,402	7·08	1·062	109·08	128	4,983	9·9	·850	2·15	·50	8·23	933·60	60	75
Darlington ...	60,000	385,999	4,140,269	10·7	·752	69	96·1	1,460	4/4	·53	1·219	·45	6·66	151·25	11	18
Darwen ...	...	266,912	2,993,697	11·22	1·25	...	...	2,182	...	·88	...	...	...	...	...	...
Derby ...	124,000	E 1,208,880 H. 17,710	12,136,148 110,231	10·039 6·224	1·011 ·935	97·88	...	2,398 ...	8/3 ...	·67 1·35	1·44 1	·75 1	6·375 ..	... ...	... ...	50 3
Doncaster ...	60,000	529,122	5,747,273	10·86	·955	95·79	93·9	1,798	7/7	·711	1·25	·76	7·5	239	18	32
Dundee ...	165,000	1,387,980	19,042,344	13·71	·853	115	...	2,387	8/2	·547	2	·50	7·3	...	...	68
East Ham ...	145,000	1,510,251	16,671,505	11·04	·78	115	150	3,704	7/1	·69	1·635	·634	7	216	32	45
Exeter ...	48,660	446,338	4,320,459	9·68	·97	88·8	82·125	2,498	7/2	·642	1·1	·902	5·76	228	16	20
Gloucester ...	53,972	624,402	4,358,510	7	·92	81	90·60	1,113	6/2	·75	1·5	·65	7·08	250·8	19	30
Halifax ...	176,000	2,330,104	20,707,071	8·89	1·27	118	81·76	2,015	12/8	·852	1·553	·82	7·23	883·74	78	101
Ilford ...	84,000	899,515	8,036,552	9·70	·758	95·7	...	2,256	5/7	·62	1·543	·69	8	...	..	26
Ilkeston ...	32,000	241,548	1,746,382	7·2	·95	...	90	1,942	52 8	·8	1·50	·5	7	101	7	13
Ipswich ...	75,681	668,650	5,715,035	8·54	·975	75·51	65·5	1,559	6/1	·84	1·53	·693	5·51	332·80	20·80	36
Keighley ...	43,000	242,500	3,099,272	12·8	·68	72·08	55·35	1,447	4/1	·462	2·22	·45	6·87	126	7	12
Kilmarnock	36,000	297,743	2,482,034	8·33	·875	68·94	93·12	1,632	5/-	·675	1·13	·86	7·22	109·14	8·76	14
Kirkcaldy ...	39,600	448,469	5,492,120	12·24	·723	138	49	1,882	8·4	·5	1·522	·64	7	158	17	22
Lancaster ...	41,786	174,752	1,603,321	9·17	·865	38·37	76	1,204	2·9	·785	1·71	·5	8	87·22	6·23	12
Leith ...	110,400	949,322	10,244,235	10·79	·86	92·8	125	2,031	6·8	·512	1·32	·72	8·3	314	21	37
Leyton ...	124,735	1,813,462	17,472,882	9·64	·950	140	120	3,820	11/1	·791	1·77	·95	8·25	14·5	40·0375	60
Lincoln ...	20,000	148,440	1,713,542	11·5	·89	85·67	59·3	2,169	6·5	·552	1·75	·428	7	72	4	8
Liverpool ...	840,000	13,657,888	145,656,374	10·67	1·127	173·40	89·09	5,516	16/3	·772	2·514	·39	7·75	5,040	420	596
Lowestoft ...	35,000	307,838	2,706,348	8	1·07	77·32	70·25	2,787	6/6	·703	1·5	·7	5·75	192	12	19
Maidstone ...	25,000	309,256	2,407,769	7·783	1·036	96·312	85	1,476	8/4	·725	1	1	6·8	133	12	19
Manchester	957,500	19,155,051	202,768,420	10·6	1·06	212	93·5	4,835	18/7	·717	2·514	...	7·75	7·2	561	683
Nelson ...	45,000	202,781	2,949,784	14·55	·88	65·55	92·59	2,796	4/9	·56	1	1	5·50	108	6	11
Newport ...	89,400	968,524	9,155,356	9·45	1·08	102·41	100	2,798	9/-	·904	1·164	·898	...	...	34	44
Nottingham	264,000	3,789,857	41,210,964	10·87	1·02	156	95·28	3,984	13/4	·646	1·75	·442	6·92	...	109	155
Oldham ...	180,000	2,077,104	22,773,108	10·963	1·19	126·52	121	3,136	12/8	·825	1·11	·884	7	846	47	92
Perth ...	35,900	252,940	1,813,228	7·16	1·15	50·5	96·25	1,298	4/7	·73	...	...	6·25	120	8	12
Plymouth ...	112,000	838,142	9 333,087	11·13	1·027	83·33	...	2,666	7·2	·639	...	...	...	...	...	42
Pontypridd ...	40,000	432,006	5,047,168	11·68	1·02	126	81·2	2,509	10/9	·71	1·25	·51	6·5	221	17	26
Rawtenstall	40,000	605,485	4,869,792	8·04	1·21	122	111	1,540	12/3	·79	1·121	·88	8·50	247·5	15	24
Rochdale ...	130,000	1,772,846	14,286,607	8·06	1·387	109·30	110·30	2,085	11/11	·78	1·07	·90	7·33	660	44	69
Rotherham ...	64,000	E 852,639 RT 128,685	9,874,231 471,690	11·58 3·67	1·08 2·72	154·3 ...	... ...	3,701 ...	13/9 ...	·76 1·92	... ...	... ...	... ...	... ...	... ...	... ...
Salford ...	350,000	6,235,278	53,124,546	8·52	1·227	151	108	3,646	15/7	·88	2·20	·46	7·916	2,054	158	200
Southampt'n	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Southend ...	78,000	637,366	7,581,104	11·89	1·09	97·2	87	4,708	8/10	·634	1·41	·76	6·5	357	21	31
Southport ...	31,312	463,262	4,663,579	10·067	·94	148·62	98	1,710	11/5	·677	1·6	·62	6·65	825	15	26
So'th Shields	111,357	898,015	10,005,164	11·414	·905	90	110	3,677	6·9	·54	3·1	·38	8·06	338	20	35
Stalybridge	94,091	1,116,936	8,406,915	7·706	1·06	89·3	...	1,353	8/-	·905	1·22	·72	6·8	...	...	60
Stockport ...	120,000	1,490,116	...	...	...	...	...	2,356	11·2	...	...	...	..	...	...	...
Sunderland ...	170,000	1,486,201	18,619,364	13·2	·97	109·5	78·3	3,696	8/10	·536	1·34	·68	7	688	43	70
Swindon ...	53,000	223,383	2,392,470	10·71	·859	45·14	75	1,955	3/4	·709	1·2	·85	6	...		12
Wallasey ...	84,500	1,291,046	13,105,204	10·15	1·15	155	99·6	3,163	14/11	1	1·89	·54	7	525	48	61
Walsall ...	100,000	720,634	6,752,727	9·371	1·184	68	94	1,905	6/7	·775	1·24	·79	7	315	21	39
Walth'mst'w	130,000	1,166,027	12,579,852	10·788	·736	96·76	95	2,883	5/11	·65	1·18	·86	7·5	430	37	38
Warrington	86,000	458,304	6,134,545	13·473	·909	71·332	102·423	2,406	5/5	·59	1·246	·803	6·401	194·86	12·179	21
West Ham ...	296,570	3,760,361	42,667,561	11·35	·852	144	90	5,041	10/-	·67	1·85	·50	7·66	1,195·75	93	118
W. Hartlep'l	90,000	479,382	4,261,917	8·89	1·07	47	94	2,163	4 3	·65	1·262	·94	7	203	14	26
Wigan ...	200,000	1,500,846	14,295,274	9·52	1·308	71·47	93·45	2,525	7/9	·74	1·15	·88	7·4	605	44	67
Wolverh'ton	135,000	1,181,309	12,236,785	10·359	1·06	90·64	89	2,539	8/1	·687	1·25	·879	6·85	651·6	36·2	52
Yarmouth ...	56,000	720,702	4,930,728	6·84	1·231	88·05	79	1,746	9/2	·857	1·25	·76	7	375	25	35
York	82,600	707,370	5,946,843	8·41	1·05	72	108	2,193	6·2	·73	1·33	·789	8	270	18	31

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast ...	390,000	6,432,600	62,340,269	9·74	1·02	159	128	2,689	13/8	·60	1·96	·43	8·75	2,014	241	290
Bexley ...	16,500	316,970	2,270,070	7·16	1·55	133	126	2,922	19/10	1·24	1·59	·63	9·5	179	11	16
Birkenhead	135,740	1,300,717	15,167,958	11·66	1·071	111·74	69·98	2,811	9/11	·71	1·39	·66	6·84	520·61	50·94	65
Bournem'uth	120,000	1,962,352	17,182,844	8·76	1·46	143	95	3,505	17·5	·824	1·19	·87	6·8	1,140	60	81
Cardiff ...	182,729	2,966,230	31,122,962	10·49	1·09	170	98·5	4,447	15/6	·65	1·44	·736	7·5	1,264	79	130
Coventry ...	135,000	1,125,705	8,407,719	7·5	1·22	62	66	2,714	6/4	·831	1·18	·866	6·4	476	40	46
Glasgow ...	1,150,000	24,214,460	336,260,758	13·887	·764	292·4	105·61	5,404	18·7	·488	2·31	·44	8·11	8,974·78	628·20	856
Huddersfield	160,000	(a) 2,797,276	23,933,065	8·69	1·24	159	84	3,556	15/6	·73	1·34	·69	7·72	1,012·16	63·26	106
Hull	291,118	4,551,145	52,087,770	11·44	·745	178·92	123·43	4,879	11/1	·52	2·75	·364	9	1,565·60	97·85	180
Leeds ...	525,000	9,522,737	95,639,268	10·04	1·075	182	115·43	3,747	16/4	(b) ·884	1·93	·539	7·54	3,465	230	345
Leicester ...	232,644	4,137,262	37,914,773	9·146	·947	163	108·35	4,045	12/10	·751	2·18	·45	8	1,451	...	160
London ...	...	E58,706,161 H 272,631	547,255,332 3,244,661	9·32 11·90	1·02 ·76	... ..	117·07 77·12	8,465 1,045	... ...	·73 1·21	... ...	... ...	8·95 5·85	17,972 131·80	1,374 10	1,730 37
Newcastle ...	300,000	5,353,875	57,840,666	10·81	1·071	193	100	3,992	16/9	·612	1·58	·633	7·5	...	133	200
Northampt'n	91,500	658,809	7,309,863	11·09	·94	82·73	...	3,102	6·4	·617	1·34	·7	...	...	...	26
Portsmouth	246,000	2,438,621	27,554,194	11·299	1·061	112·01	90·29	3,535	9/1	·495	1·66	·62	7	1,065	74	100
Preston ...	120,000	1,025,738	10,340,688	10·08	1·04	86·17	132	2,652	7/7	·764	1·01	·95	7·36	404·7	21·3	33
Reading ...	76,500	941,303	8,865,128	9·42	·97	116	110·5	2,680	9/2	·54	1·59	·68	7·5	352	26	36
Sheffield ...	485,228	8,810,252	107,023,195	12·147	·878	220	108·86	4,950	16 2	·553	2·917	·371	...	3,215·05	221·728	339
Wellington	70,000	2,328,849	24,565,376	11·28	1·43	359	85	4,708	44/10	1·031	1·125	·89	7·59	840	75	92

E—Electric trolley system. H—Horse lines. (a) Including 9,467 miles coal haulage. (b) Total expenses per passenger.

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CONTRACTS AND ORDERS.

Ilford Council have purchased a tramcar from Barking Council, at £460.

Chatham Council have decided to purchase a steam tractor and two trucks at an estimated cost of £623.

Edinburgh Council have accepted Messrs. G. and R. Cousins' tender for foundation work at the new Portobello power station.

Glasgow Tramways Committee have accepted offers for special trackwork by the Lorain Steel Company and Messrs. Edgar Allen and Company.

Worcester Council have agreed to purchase a four-retort stoker from Erith Engineering Company, payment to be made on conclusion of the war.

Dick, Kerr and Company's tender to Kingston-upon-Hull Electricity Committee for the supply of a turbo-generator at £13,315 has been accepted.

Rotherham Council have placed a contract with Chadwick and Company, Limited, for the extension of the boiler house at the electricity works, at £1,854.

The Chloride Electrical Storage Battery Company's tender for the maintenance of batteries of electric vehicles has been accepted by Wolverhampton Corporation.

The Woods-Gilbert Rail Planer Company, Limited, of 2 and 3, Norfolk Street, London, W.C., have undertaken to remodel portions of the Wigan Corporation tramway track.

Contract for Petrol.—The Anglo-American Oil Company, Limited, have been awarded the contract for the supply of petrol for a year to Rotherham Council at 1s. 0½d. per gallon.

Southampton Council have accepted the tender of Messrs. Cory Brothers and Company for 6,000 tons of coal at 21s. 3d. per ton, and 2,000 tons from Messrs. A. Usher and Company at 21s. 9d. per ton.

Barking Town Council have placed an order for a 1,000-KW. turbo-alternator with the Brush Electrical Engineering Company. The order includes condensing plant, piping, stoker, economiser, etc.

The Price of Copper.—In consequence of copper showing a tendency to decline in price, Barnes Electricity Committee have deferred the purchase of a supply of cable in the hope of a further fall.

Siemens Brothers Dynamo Works, Limited, have received the following contracts:—Manchester Corporation, metal filament lamps; Great Central Railway, Wotan lamps; Leith Corporation, Tantalum traction lamps.

The Railway Track Supply Company have received through the India Office an order for 65,000 of their Vaughan rail anchors for the North-Western Railway, India. This is the second order received from this company since January last.

Rotherham Electricity and Tramways Committee have placed an order with Earl Fitzwilliam's Collieries for 6,000 tons of slack at 14s. per ton, and with Sheepbridge Coal and Iron Company for 4,000 tons of Glapwell smudge at 11s. 8d. per ton.

Woolwich Council have accepted the following tenders:—Messrs. Babcock and Wilcox, Limited, coal and ash-handling plant, coal chutes and rack valves, £1,175; Messrs. Willans and Robinson, Limited, set of reaction and impulse blading for turbines, £94 10s.

Sunderland Council have placed the following contracts:—Links for chain-grate stoker, Messrs. Babcock and Wilcox, Limited; cable racks and wood cleats, British Insulated and Helsby Cables, Limited; 288 ft. of mild steel angle bar, South Durham Steel and Iron Company.

Melbourne Council have placed the following contracts:—Messrs. Babcock and Wilcox, Limited four mechanically-fired boilers, £840; Messrs. W. and T. Avery, Limited coal-weighing machine, £2,740; Messrs. Strachan, Murray and Shannan, two fuel economisers, £1,816; Mr. C. W. Webster, arc lamp carbons of Spanish manufacture, £3,431.

Victoria State Railways Commissioners have placed with Messrs. Crompton and Company the contract for the equipment of the Ballarat and Bendigo workshops of the State Railways Department. Siemens Bros.' Dynamo Works, Limited, have obtained the contracts for switchgear and accessories required for the electrical equipment of Melbourne Suburban Railways.

The General Electric Company, Limited, have been awarded a yearly contract by the Great Northern Railway Company for the supply of standard Osram drawn wire lamps and for Osram "Atmos" type lamps. These lamps are manufactured at the Osram Lamp Works, Hammersmith, London, the bulbs being blown at the Lemington Glass Works, Newcastle-on-Tyne.

Salford Council have accepted the tender of Messrs. F. Mitchell and Son, Limited, for alterations to buildings and the construction of foundations at the electricity works in connection with the installation of an additional 5,000 KW. turbo-alternator. The tender of Messrs. Aiton and Company, Limited, Derby, has been accepted for the supply of mild-steel and cast-iron pipes and separator.

Sydney Council have allotted tenders as subjoined:—5,000 and 10,000 volt switchgear, Messrs. N. Guthridge, Limited, £5,958; transformer, distributor and summation panels, British General Electric Company, Limited, £2,868 18s.; low tension direct current feeder panels, Australian General Electric Company, £248; steel towers for overhead transmission, Messrs. Poole and Steel, £9,300.

New York Subway Contract.—The Public Service Commission for the First District of New York has awarded the contract for the construction of Section No. 1 of Route No. 29, the Nostrand Avenue subway in Brooklyn, to Newman and Carey Company, Brooklyn, for $2,073,303.20. The Nostrand Avenue subway is a branch of the Eastern Parkway subway, which in turn is an extension of the existing subway, and will be operated in connection therewith by the Interborough Rapid Transit Company.

Sheffield Council have confirmed the following contracts placed by the Tramways and Electric Supply Committees:—Mackintoshes for women conductors, C. Mackintosh and Company, 28s. 6d. each; erection of pump room at Neepsend power house, Messrs. H. Boot and Sons, £2 853; steam pipes, Stewarts and Lloyds, Ltd., Glasgow, £60; water recording apparatus, Lea Recorder Company, Limited, Manchester, £115; water pipes, Sharpe and Company, £200; switchgear, Reyrolle and Company, Limited, Hebburn-on-Tyne, £240.

Victorian Railway Commissioners have accepted the appended contracts:—British Pneumatic Railway Signal Company, impedance bonds and relays; Herbert Morris, Limited, overhead cranes, etc.; McKenzie, Holland Westinghouse Power Signal Company, track resistances; British Insulated and Helsby Cables Ltd., cables, overhead equipment of permanent way and overhead transmission mains; Austral Otis Engineering Company, street railway and tramway crossing; British Insulated and Helsby Cables, copper wire.

New Car Equipments for Reading.—An order has been given by Reading Council to Dick, Kerr and Company, Limited, for six car sets, comprising 12 motors and 12 controllers, at a total cost of £1,596 net. Replying to objectors, Alderman C. G. Field, chairman of the Tramways Committee, stated that if the order was not given, they would have to spend a sum within £100 or £200 of the total cost of the order on repairs, and would then have old articles instead of new ones. At present the staff could not keep up with the repairs of the old sets as they had done in the past. During the last six years the cost of repairs had advanced by £1,000 a year.

Elwell-Parker Trucks.—The Railway Track Supply Company, who are the sole agents for the Elwell-Parker Electric Company, Cleveland, Ohio, U.S.A., inform us that they have received an order from the London and North Western Railway for ten Elwell-Parker trucks; also a repeat order from the Lancashire and Yorkshire Railway for four Elwell-Parker trucks. Since the introduction of these battery vehicles into England, most of the important railways are now using them, and some of the most prominent industrial firms in this country. They are very useful in shops, and tramway managers might investigate their advantages with a view to their employing them as parcel trucks.

Government Contracts.—During the month of July the following Government contracts were awarded:—

MOTOR AMBULANCES. D. Napier and Son, Limited, Acton, W.

MOTOR LORRY BODIES (term contract).—Bayleys, Limited, Newington Causeway, S.E.; E. and H. Hora, Limited, Peckham Road, S.E.; Regent Carriage Company, Limited, Fulham, S.W.

MOTOR BODIES. Alford and Alder, Newington Butts, S.E.; Army Motor Lorries and Wagon Company, Limited, Hayes, Middlesex; Cunard Motor and Carriage Company, Limited, Putney, S.W.; Maythorn and Son, Limited, Biggleswade; Million-Guiet, Stanley Works, Cricklewood, N.W.

ELECTRIC CABLE AND WIRE.—British Insulated and Helsby Cables, Limited; Callender's Cable and Construction Company, Limited; W. T. Glover and Company, Limited; A. Green, Limited, Derby; W. T. Henley's Telegraph Works Company, Limited; Hooper's Telegraph and India-Rubber Works, Limited; Liverpool Electric Cable Company, Limited; Midland Electric Wire Company, Limited; Siemens Bros. and Company Limited; Ward and Goldstone, Salford.

MOTOR FIRE ENGINES. Merryweather and Company.

TRACTION ENGINES.—Ransomes, Sims and Jefferies, Limited.

GENERATING SETS (parts).—Austin Motor Company (1914), Limited.

Sydney City Railway.—A Sydney newspaper states that the city electric railway is to be commenced as soon as Parliament has given its sanction to the scheme. It is intended to connect North Sydney and the Nelson's Point Railway.

Remarkable Car Maintenance.—In the current issue of the *Tramway Bulletin*, the employees' magazine of the Denver Tramways Company, Mr. W. C. Metzger, foreman of the armature department, states that through the use of the electrolytic lightning arresters on the cars, improved operation of cars and better methods in the armature room, it is now possible for five men to look after the repairs of the following equipment:—245 motor passenger cars; 32 motor utility cars; 203 air compressors; 91 extra armatures of eleven types; 4,200 field spools; 825 resistance boxes; 290 lightning arresters; 40 stationary motors and starting boxes; all arc headlight resisters and coils; coasting clock coils; electric track switches; bonding car; concrete mixer; elevator motors; rock-quarry apparatus and crusher; and various pieces of electrical apparatus used on cars and in buildings. The number of armatures looked after is 1,109.

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PERSONAL.

Mr. F. H. Whysall, burgh electrical engineer, Greenock, has been voted an increase of £100 per annum in his salary.

Private F. Gertson, formerly an employee of the Blackburn Corporation Tramways, has been recommended for gallantry in the field.

Mr. W. W. Lackie, city electrical engineer, of Glasgow, has been appointed President of the Institute of Shipbuilders and Engineers of Glasgow.

Mr. E. Carden, general manager, Dover Corporation Tramways, has held his position since the inauguration of the undertaking 18 years ago.

Mr. Thomas Britten, manager of the works of Crompton and Company, Limited, at Chelmsford, has been elected a director of the company.

Mr. J. G. B. Stone has been elected a director of the Madras Tramways Company to fill the vacancy caused by the death of Mr. T. E. Ivens.

Mr. E. de Normanville has been appointed secretary to the agents' section of the Society of Motor Manufacturers and Traders and the Motor Trades Association.

Mr. W. G. T. Goodman, chief engineer and general manager of the Adelaide Tramways Trust, has two sons who have joined the forces and are proceeding to the front.

Mr. A. Campbell Swinton, a director of Messrs. Crompton, Limited, has presented a projector barrel and stand to the Engineering Institutions Volunteer Training Corps.

Mr. R. H. Lee, engineer in charge of Stockport electricity works, has resigned to take up a similar position with the North Metropolitan Electric Power Supply Company.

Mr. A. J. Bousfield, assistant manager of the Isle of Thanet Tramways Company, has been appointed to a similar position with the Chatham and District Light Railway Company.

Mr. W. Morgan, professor of automobile engineering at the University of Bristol, has been liberated from his professional duties for the period of the war to take up munition work.

Mr. V. H. M. McMahon, foreman at Hyde Road car shed, Manchester Corporation Tramways, who enlisted as a private in the A.S.C. Motor Transport Section on June 16 last, has been promoted to staff-sergeant.

Mr. H. Mattinson, A.M.I.C.E., chief civil engineer of the Manchester Tramways Department, has been granted a commission as lieutenant in the 73rd (East Lancashire) Territorial Unit of the Royal Engineers.

The late Earl of Jersey, for many years chairman of the Light Railways Commissioners, is to be commemorated by a memorial in Oxfordshire. The Duke of Marlborough has started the fund with a contribution of 200 guineas.

Mr. E. J. Cochrane has resigned the office of deputy general manager of Sydney Council's electricity undertaking. The Council have passed a resolution expressing regret at his resignation and appreciation of his services.

Mr. J. W. Spark, recently appointed borough electrical engineer at West Hartlepool, has received from Plymouth Council a resolution expressing high appreciation of his valuable services as engineer to their electricity undertaking.

Mr. J. Prater, a clerk in the Wallasey Corporation Tramways Department, who has been serving with the Army since the outbreak of the war, has received a commission in the Mechanical Transport Department of the A.S.C.

Corporal W. Entwistle, of the Royal Flying Corps, was before enlistment an apprentice with the South Lancashire Tramways Company. He received his chevrons in recognition of a flight he made in the locality of the North Sea.

Commander Boissier, D.S.O., of the Howe Battalion, Royal Naval Division, is mentioned in Sir Ian Hamilton's despatches from Turkey. The gallant officer went to the Royal Naval Division from Derby Corporation electricity department.

Sir David Harrel, who has conducted arbitrations between Corporation tramway owners and their employees, has been appointed a member of the Committee of Production, to act in the absence at any time of Sir George Askwith, Sir Francis Hopwood, or Sir George Gibb.

Mr. J. Dalrymple, general manager, Glasgow Corporation Tramways, attended a meeting of Aberdeen Tramways Committee on August 19 to report upon the suggestion that Aberdeen Corporation should take over the undertaking of Aberdeen Suburban Tramways Company.

Dr. H. S. Hele-Shaw, president-elect of the engineering section of the British Association, has expressed a hope that the meeting at Manchester in September may lead to the work of the chemistry, economics, engineering, and other sections being utilised in connection with the war.

Mr. R. Wright has received a presentation from the officers and employees of the Cleveland and Durham Electric Power Company on resigning his position as district engineer at Bishop Auckland. Mr. Wright has been appointed mains engineer to a railway company in the Argentine.

Mr. I. Bulfin, general manager, Bournemouth Corporation Tramways, with the consent of the Corporation, has undertaken to render assistance in the local Munitions Committee. He has also been authorised to obtain such small additional plant as may be required for the purpose.

Mr. J. S. D. Moffet, general manager, West Ham Corporation Tramways, is to be responsible for the control and maintenance of the track, which has been transferred from the Highways Committee to the Tramways Committee. As a consequence the next two increments in salary which Mr. Moffet will receive have been raised from £50 to £100 per annum.

Mr. O. W. Brain, electrical engineer, New South Wales Railways and Tramways, recently made presentations of wrist watches to members of his staff who have joined the Forces. Adverting to the deeds of the Australians in Gallipoli, he observed that the moral courage and stamina that had made Australians leaders in healthy sports was now finding repetition on the field of war.

Sir Albert H. Stanley, managing director of the London Tramways, Omnibuses, and Tubes Companies, is defraying the cost of providing tea at treats which are being given to wives and children of the London United Tramways employees now serving their King and country. The treats take place at some rural spot near each depot, and the incidental expenses and the cost of prizes are defrayed by the employees and the various clubs and institutes.

Inspector W. F. Richardson, of the Birmingham Tramways Department, has received a commission in the 18th (Service) Battalion of the Middlesex Regiment. On leaving the Army with the rank of colour-sergeant, Mr. Richardson became a conductor on the Corporation tramways, and rose to the position of inspector. On the outbreak of war he rejoined the army and was appointed drill instructor to the 3rd City Battalion at Moseley College.

Mr. A. E. Frostick, general secretary, Anglo-Argentine Tramways Company, has been elected the first president of the social club inaugurated for the office employees of the company. For this purpose a portion of the old central station has been placed at the disposal of the staff by Mr. Pedriali, the general manager of the company. At the opening proceedings the speakers included Messrs. Frostick, Pedriali, and Valentine Brown, traffic manager of the Lacroze Tramways.

Mr. F. H. Corson, general manager and electrical engineer, Gloucester Corporation electricity and tramways departments, has been congratulated by the Committee and the Council upon being able to present so satisfactory a report for a year which has included eight months of the war. The City High Sheriff said that in committee it was his pleasure to offer Mr. Corson the congratulations of the committee, and he would like to give public expression to those congratulations, and to assure Mr. Corson that he enjoyed the confidence of the whole Council.

Mr. Cecil Peters, after 34 years' service with the New South Wales Tramways, has retired. Mr. H. Richardson, the Commissioner, who has since died, in presenting a clock to Mr. Peters as a symbol of the regard felt for him by the employees, said the recipient started as a conductor and rose to the position of depot master at Dowling Street, Sydney. Mr. E. J. Doran (tramway superintendent) and Mr. Neale (assistant superintendent) also spoke. Mr. Peters has since received a handsome gift from his brother officers. The men's recreation club has for many years been an object of his care.

Mr. C. R. Everson, general manager, Plymouth Corporation Tramways, has received a readjustment of the terms of his engagement consequent upon the Council taking over the Devonport and District Tramways Company's undertaking on October 2 next. Mr. Everson's salary has been fixed at £450 per annum, with house. Under the scheme for the enlargement of the borough, Mr. Everson would have been entitled to retire upon compensation had he not been appointed general manager. Councillor Debenham remarked that those who knew Mr. Everson's work were aware that he was paid far below his value.

Mr. G. R. G. Conway, as already recorded in these pages, has resigned his position as chief engineer of the British Columbia Electric Railway, in order to take up work as a consulting engineer in Toronto. He will also act in a similar capacity for the British Columbia Electric Railway Company. Before leaving Vancouver he was entertained at a complimentary dinner by the officials of the company, when Mr. Kidd, the general manager, presided, and the guest was presented with a silver rose bowl. A cablegram was read from the directors in London expressing regret at the retirement of Mr. Conway and appreciation of his good work for the Company.

Mr. R. S. Pilcher, general manager, Aberdeen Corporation Tramways, was referred to in the remarks made by Councillor Robertson, chairman of the Tramways Committee, in submitting the annual report of the department to the Council. Councillor Robertson said he was sure the Council would appreciate the way Mr. Pilcher had

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carried out his work during the year with so many new men and women to train. He had had his hands quite full, and they would always find him at his duty. He had been loyally supported by an excellent staff, who had worked at high pressure. There had not been one complaint. The success of the undertaking was entirely due to the splendid organisation and work of the manager and his staff.

Messrs. Kennedy and Donkin have been re-engaged by London County Council to advise and report on work connected with the Greenwich generating station and other engineering work of the tramways department. Their retaining fee is £500 per annum, and the agreement is for one year, and thereafter subject to three months' notice of the determination of the engagement. As regards new constructive work, a commission of 5 per cent. is to be paid on the certificated cost of plant, etc., up to £50,000 a year, and 4 per cent. on any expenditure exceeding that amount, except that the commission on new constructive work connected with the second stage of the Greenwich generating station carried out substantially to specifications prepared by the chief officer of tramways shall be 3 per cent.

Mr. Harry Richardson, Assistant Commissioner for the New South Wales Government Tramways, has passed away after 49 years' service in the railways and tramways departments.

Sergeant J. W. Boothman, of the 6th Battalion Lancashire Fusiliers (Territorial Force), formerly a motorman in the employment of the Rochdale Corporation Tramways, died a few hours after being wounded at the Dardanelles on Sunday, July 18.

Mr. John Kerrigan, who recently died at Preston, entered upon tramway work many years ago on the recommendation of Sir Thomas Forward. When electric traction was first introduced at Liverpool, Dudley, Norwich, Batley, Douglas, and Colombo, he acted as traffic superintendent.

Motorman Edward Carss, of the London United Electric Tramways, who died at the age of 45, after a nine months' illness, had proved his gallantry both in war and in civil life. In the Boer war he gained the distinguished conduct medal for repairing a telegraph line, thus enabling relief to be sent to his company of the Yorkshire Light Infantry when they had been surrounded. He set out with two horses on his task, and on his return he was wounded in the leg, and one horse was killed, and the other wounded. At Brentford, in 1906, he left his car and assisted a constable who was being assaulted. For this act he received a presentation from the police. A year ago he rescued a child from a burning house. His remains were interred with semi-military honours at Twickenham on August 19.

THE LATE ROBERT HAMMOND.

We regret to record the death of Mr. Robert Hammond on August 5. Mr. Hammond, who was 65 years of age, was one of the pioneers of electric lighting and traction in this country, and he designed the first central stations for lighting. In 1878, when he turned to electrical engineering, he was the head of an engineering firm in London and Middlesbrough. He paid several visits to the United States in order to study the progress which had been made in the application of electricity to tramways. Before those visits he had acted as consulting engineer for numerous electric supply undertakings, and after his studies abroad he devoted some attention to electric traction in this country and the Colonies. Mr. Hammond also instituted a training college for electrical engineers, and in 1890 he founded the Electrical Standardising, Testing, and Training Institution. His services were frequently sought in arbitrations, and as a witness before Parliamentary Committees. The funeral took place at Golders Green Crematorium on August 9. Many well-known members of the Institution of Electrical Engineers were present, including Sir John Snell, president, Mr. A. Siemens, Mr. W. M. Mordey, past presidents, and others. Messrs. Robert Hammond and Son, 64, Victoria Street, Westminster, S.W., in announcing the death of Mr. Robert Hammond, state that it is the intention of the firm to carry on the practice under the old name and at the same address. Pending the return to civil life of the junior partner, Captain R. W. Hammond, now on active service, Messrs. Preece, Cardew, Snell, and Rider have undertaken to execute, on behalf of the firm, all work now in hand and any future work which may be entrusted to the firm.

War Collections on Auckland Tramways.—Mr. C. G. Tegetmeier, chairman of the Auckland (N.Z.) Electric Tramways Company, writing from the Electric Federation Offices, Kingsway, London, states that from May 6 to May 22 the conductors on the Auckland cars sold 100,174 penny tickets for the benefit of the Belgian Relief Fund, resulting in the collection of £417 7s. 10d. for that object. The same scheme was adopted in aid of the funds for providing the New Zealand hospital ship and aiding the War Relief Association. During eight days up to the date of the mail leaving, £203 8s. had been collected.

RAILWAY APPOINTMENTS.

Mr. J. K. McNellie has been appointed general superintendent of the Intercolonial Railway of Canada.

Mr. F. P. Brady has been appointed general manager of the National Transcontinental Railway of Canada.

Mr. Vernon Hinde has been appointed secretary to the San Paulo (Brazilian) Railway, in place of Mr. W. H. Moxey, retired.

Capt. C. L. Conacher, attached to the Ministry of Munitions, has been graded staff captain on the War Office Headquarters Staff.

Mr. F. H. Dent, general manager, South Eastern and Chatham Railway, has been awarded the Cross of the Legion of Honour in recognition of his great services to France.

Mr. A. Blanden, station superintendent at the Marylebone terminus of the Great Central Railway, has received a commission in the army, after service as a non-commissioned officer.

Captain W. E. Thornhill, engineer of the central division of the London and North-Western Railway, is serving as captain of the 115th Company (Railway Troops), Royal Engineers.

Captain E. O. Milne, of the New South Wales Railways, who during the winter was railway transport officer at Cairo, and a detachment of 280 men volunteered for duty in the Dardanelles.

Mr. E. A. S. Bell has been appointed agent of the Eastern Bengal State Railway in place of Col. C. A. R. Browne, R.E., whose services have been placed at the disposal of the Commander-in-Chief in India.

Major R. L. Wedgwood, R.E., chief goods manager and passenger manager, North Eastern Railway, who has been acting as deputy assistant director of railway transport in France, has been recalled for service in England.

Mr. E. A. Hart, on retiring from the post of accountant to the Cardiff Railway Company, has been presented with an illuminated copy of a resolution passed by the directors, thanking him for his long and faithful service, and with a silver tea and coffee service by the officers and staff.

The Duke of Devonshire having been appointed a Civil Lord of the Admiralty, has resigned his directorships, including the chairmanship of the Furness Railway. Lord Muncaster, the deputy chairman, has been appointed chairman, Mr. F. J. Ramsden, vice-chairman, and Mr. M. Kennedy a director.

Major R. Blakeney, D.S.O., R.E., deputy general manager, Egyptian State Railways, some time ago went to the Dardanelles to superintend the construction of a railway of two feet gauge on the Gallipoli Peninsula. The line is already in use, and as the operations against the Turks develop it will be extended.

Mr. Howard Williams has been appointed mineral traffic manager of the London and North-Western Railway. He entered the company's service in 1897, and among the appointments he has held are those of assistant goods manager at Wolverhampton and Liverpool, and head of the employees' conciliation department.

Mr. T. W. Watts, who in May last was appointed to the new post of commercial superintendent, Great Eastern Railway, was recently presented with a silver entree dish and an address by the indoor and outdoor staff of the district goods manager's office at Ipswich. Mr. Watts for some years occupied the position of district goods manager.

Mr. Wm. Stormont is the manager of the suite of London offices that have recently been opened by the Italian State Railways at 12, Waterloo Place, Regent Street. He has had many years' experience in the Continental department of the South-Eastern and Chatham Railway, and is familiar with the Italian railways and the social and business life of Italy.

Mr. C. E. Ellis, managing director of John Brown and Company, Limited, for the last 25 years, has resigned that appointment, and also that of director of the Coventry Ordnance Works, in order to place his services at the disposal of the Ministry of Munitions. Mr. Ellis, who has for many years acted as hon. treasurer of the Institution of Naval Architects, has been elected a director of the Great Eastern Railway Company.

Ambulance Trains Committee.—The Railway Executive Sub-committee, through whom the order for several ambulance trains has been placed by the War Office, consists of Mr. F. H. Dent, general manager of the S.E. and C. Railway Managing Committee; Sir William Forbes, general manager of the L.B. and S.C. Railway, and the carriage superintendents of the railway companies building the trains. Mr. H. J. Moore is the secretary of the sub-committee.

Mr. E. H. Hiley, formerly of the North Eastern Railway, who became general manager of the New Zealand Government Railways in Nov., 1913, has issued a report recommending reforms in the organisation of the railway, which has outgrown its present organisation. He advises the appointment of a number of additional chief officers, including an electrical engineer from outside New Zealand with an experience of electric signalling and interlocking installations. The department, Mr. Hiley says, is short of engine power and rolling stock. The terminal accommodation is inadequate at several important centres, and a forward policy is necessary in regard to duplication of congested suburban lines, regrading of main lines, bridge strengthening, and additional signalling equipment.

M. Fournello, of the Luxemburg Prince Henry Railway, has, according to the *Cologne Gazette*, been sentenced to death for conveying information regarding German troops to the French.

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TRAMWAY AND LIGHT RAILWAY NOTES.

BRADFORD.

THE QUESTION OF CONTROL OF THE TRACK.

In reply to questions at a recent meeting of Bradford Council concerning reports which had been prepared on the laying of Bingley tramways track, Councillor Priestley, chairman of the Tramways Committee, said that he had withheld nothing from that committee. He had no objection to taking the minute back in order to confer with the Street, Drainage, and Works Committee. So far as the track was concerned, there had been a great waste of public money in the overlapping of the work of the two committees. The minutes relating to the matter were referred back.

HULL.

THE UNIFICATION OF CONTROL REPORT.

Hull Corporation recently considered the report of the Special Departments Inquiry Committee, who had made various recommendations. Dealing with the Tramways Department, they recommended that the Tramways Committee be requested to prepare and submit to the Council a scheme for the unification of control under a general manager, who should be responsible for the whole undertaking, and should have control over all men engaged in tramway work, including those in the Corporation workshops. The proposal, however, was rejected by the Council.

LEEDS.

WAR COLLECTIONS.—USED TICKET BOXES.—THE RAILLESS TROLLEY EXTENSION.

Leeds Corporation have confirmed the action of the Tramways Committee in agreeing to arrangements for collecting donations on the cars for the duration of the war. The ticket boxes on the platforms of the tramcars have been fitted with a smaller aperture and placed inside the saloon. During their removal the boxes have been greatly missed by passengers, thus showing that the receptacles have answered their purpose well. The boxes are now to be used also for collecting money for war funds. Replying to Otley Council, Mr. J. B. Hamilton, general manager, Leeds Tramways, has stated that he is unable to name a date for the opening of the railless trolley installation between Guiseley, Otley, and Burley. The delay in completing the work is due to the difficulty of obtaining material for the overhead equipment and to the shortage of labour.

LEICESTER.

ADDITIONS TO GENERATING PLANT.—NEW CAR REPAIR SHOP.

At a cost of nearly £60,000, the Tramways and Electricity Committee have made additions to the plant at the Lero power-station and erected a new repairing shop at the Abbey Park Road car-shed. At the power-station two turbines, etc., have been added to the one previously in existence. Two water-tube boilers have been installed, the old boiler-house holding eight Lancashire boilers fed by mechanical stokers. The shaft to the new building is 212 ft. high. The car-body shop is 362 ft. long by 43 ft. wide, the paint shop 296 ft. by 43 ft., the varnish shop 66 ft. by 43 ft., and the timber store 87 ft. by 33 ft. A tower wagon house, garage, petrol store, heating chamber, office, cycle shed, and lavatory have also been provided. A pneumatic shaving and dust removing installation discharges the rubbish of the body-shops into the heating chamber. The new buildings were designed and supervised by Mr. E. G. Mawbey, borough and tramways engineer, while Mr. T. R. Smith, electrical engineer, was responsible for the erection of the plant.

LONDON.

DUPLICATION OF TRANSPORT SERVICES.—GRANTS TO EMPLOYEES.—ARBITRATION AWARD ACCEPTED.—WOOD PAVING.

LONDON UNITED CONCESSIONS.

So far no date has been fixed for the suggested and much needed conference between the President of the Local Government Board, the London County Council and other owners of street traffic undertakings with a view to the abolition of duplicated transport services during the continuance of the war. Before the Council rose for the recess they voted the sum of £1,189 to be disbursed among the operative staff who remained loyal during the recent strike, and also among members of the department who carried on the unusual duties. As the result of the ballot of the London County Council's tramway employees on the award of the Conciliation Board, a large majority have declared in favour of accepting the award. The figures were:—For the award, 2,606; against, 1,626. The offer of the Conciliation Board was that the bonus of 3s. per week, or 6d. a day at present confined to men earning less than 30s. a week, shall be extended to men earning 40s. per week and under. This grant is to be paid during the continuance of the war, provided that it does not extend beyond a period of three years. Wandsworth Council have asked the County Council to substitute wood paving for granite on several tramway routes in consequence of a complaint by the Master Carmen's Association that most breakdowns of horse vehicles are caused by defective tramway lines. The directors of the London United Tramways have extended to all hours the half fares for children. Hitherto the privilege has been granted only during school hours. A system of transfer tickets is to be instituted in September, according to a communication received from the company by Hampton Council.

MANCHESTER.

THE WAR BONUS ARBITRATION.—WAR COLLECTIONS.—ROLL OF HONOUR.

Sir George Askwith, Sir George Gibb, and Sir Francis Hopwood, constituting the Committee on Production, have awarded a "war bonus" as follows to Manchester tramway employees:—1s. per week between 18 years of age and 21 years, and 2s. per week to employees aged 21 years and upwards in receipt of 38s. per week or less; employees receiving over 38s. per week and under 40s. are to be paid a "bonus" sufficient to raise the normal weekly wage to 40s. The award will increase the cost of the bonuses from £7,142 to £17,000 per year. Mr. J. M. McElroy, general manager of the tramways, has announced that up to the first week in August the total sum collected in the boxes at the rear of each car was £13,860, this amount being made up in the main by copper coins, the most conspicuous of which have been the halfpennies. The organisations assisted have been:—Local Relief Fund, British Red Cross Society, Wounded Belgians' Fund, Polish Relief Fund, Base Hospital in France, Motor Ambulance Fund (Y.M.C.A.), Serbian Relief Fund, Fund for British Prisoners of War in Germany, Convalescent Hospital in Alexandria, etc. More than 2,000 employees of the Corporation Tramways have joined the forces. Their names and departments of those in the tramway service appear on a mammoth poster which has been put up in the depots and workshops.

WALTHAMSTOW.

POLICE REFUSE TO LICENSE WOMEN CONDUCTORS.—PURCHASE OF WELDING APPARATUS.

At Stratford Police Court on August 14, Mr. Wm. Murray, manager of Walthamstow Council Tramways, was summoned for employing two unlicensed men as motormen on August bank holiday; and the men were summoned for driving without having first obtained licenses. Mr. Murray admitted the offence, and took full responsibility. He explained that fully one-half of the entire staff had either enlisted or gone to munition work. He had twice approached the Commissioner of Police asking him to license female conductors, but this concession had been refused. His Council felt this refusal so keenly that they had asked the Home Secretary to meet a deputation on the subject. The men summoned were fully qualified motormen who had made application for licenses some weeks previously. The Bench dismissed all four summonses on payment of costs. Councillor W. R. Clarke, chairman of the Tramways Committee, has informed the Council that an acetylene welding apparatus has been purchased for the improvement of the track, and it was hoped that in future the cars would run more smoothly and with less noise.

WEST HAM.

TRAMWAYS COMMITTEE TO CONTROL TRACK MAINTENANCE

West Ham Tramways Committee have induced the Corporation to agree to the transfer of the control of the maintenance of the tramway tracks from the Highways to the Tramways Committee. Mr. Moffet, the tramways manager, has reported that when the work is taken over the principal staff that will be required to carry out the work in a proper manner should consist of the following members:—A civil engineering assistant, a surveying assistant and draughtsman, a general foreman, and a foreman platelayer. The approximate salaries and wages would amount to about £700 per annum. The Corporation have altered the title "tramways manager" to that of "general manager."

PATENT LIST.

Specially abstracted for "The Tramway and Railway World" from the Official Journal of Patents.

*** If the inventions have been communicated the names of the communicators are given below in *italics*.

APPLICATIONS.

The following Applications for Letters Patent have been filed:

10,890 Motor road vehicles—R. Booth.
10,915 Motor vehicles—Daimler-Motoren-Ges.
10,957 } Electric railway systems—The Rt. Hon. H. L. Samuel,
10,958 } W. Slingo, and others.
11,068 End door fastening for railway and tramway vehicles—C. Roberts and Company, Limited, and D. Bailey.
11,087 Railway chair keys and wedges—R. Bowen.
11,133 Rail joints—L. W. Macer.
11,139 Switch device for car-lighting dynamos—Albion Motor Car Company, Limited, and T. B. Murray.
11,172 Means for suspending and adjusting electric overhead conductors—British Insulated and Helsby Cables, Limited, and J. W. Astley.
11,275 Train lighting systems—Vickers, Limited (*F. Krizik*).
11,395 Mudguards for the wheels of motor omnibuses—C. Newton.
11,410 Trolley wheels for electric tramcars, etc.—E. J. Neachell and L. Loukes.
11,490 Brakes for motor road vehicle trailers—E. M. Tailby.
11,562 Tires for vehicle wheels, omnibuses, etc.—A. Northover.
11,582 Wheels for motor vehicles—T. G. Jelly.

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11,609 Chairs for railway rails—W. C. Letts.
11,625 } Fluid-pressure braking apparatus—Westinghouse Brake
11,626 } Company, Limited.
11,707 Motor vehicles—A. A. Scott.
11,771 Fluid-pressure braking apparatus—Westinghouse Brake Company, Limited.
11,807 Machine for issuing fare tickets and for totalising issue of same—E. G. Judd and W. Pickering.
11,891 Rail ties and fastenings—I. Carey.
11,938 Electric distributing systems for motor road vehicles—H. Lucas and C. L. Breeden.
12,011 Tires for motor road vehicles—E. J. Falla and A. Meadows.

FOR HIGH-CLASS
CONDENSING PLANT
WRITE TO
THE MIRRLEES WATSON CO., LTD.,
SCOTLAND STREET, GLASGOW.

AILSA OILSKINS
Give Genuine Satisfaction.
MOTORMEN'S COATS.
Write for sample of latest improved pattern, specially adapted to withstand the excessive friction at sleeves and under arms in driving.
The Manager of a well-known tramway company writes:—"Past results have been so satisfactory that we have this year decided to place the whole of our order in your hands."
AILSA OILSKIN CO.,
Manufacturers, Dalry, near Glasgow.

Specifications Published.

1913.

25,951 Trolley wires for electric railways—Lautenbacher.
27,828 Built-up iron railway sleepers—Matthael.
28,727 Internal combustion traction motor for use in shunting and other railway work—Bräuer.
29,689 Electrically-actuated mechanism for controlling trains from a distance—Wirth.

1914.

9,988 Hydraulic brakes—Junkers.
12,833 Hollow railway sleeper of reinforced concrete—Michael.
15,562 Radiators for motor vehicles—De Boischevalier and Chevrolet.
15,946 Junctions for overhead trolley wires—Cedes Electric Traction, Limited, and Bowen.
16,320 Chain grate stokers—Babcock & Wilcox, Limited.
16,430 Steering and braking mechanism of vehicles—Charley.
18,338 Throttling devices for the engines of motor-propelled vehicles—Finch, Wordingham, Loftus, and Lambourne.
22,259 Car trucks—Adams.
23,595 Laminated springs for railway and tramway vehicles—Samuel Osborn and Company, and Hurst.
963 Electrically-driven vehicles—Von Kando.
3,318 Trolley heads for electric tramcars, locomotives, etc.—Johnston and Green.
16,914 Chain grate stokers—Babcock and Wilcox, Limited, and Metcalf.
18,863 Couplings for Westinghouse brakes—Robertson.
19,021 Means for securing rails to sleepers—McDermott.
19,581 Life guards for road vehicles—Mathews.
9,835 Permanent ways for tramways—Schmidt.
10,617 Means for preventing the creeping of railway rails—Rambacher.
10,957 Axle-bearing for railway vehicles—Zechmeister.
15,449 Rail joints—Young.
17,335 Trolley wheels—Adam and Adam.
18,674 Apparatus for grinding tramway rails—Laing and Butler.
20,871 Electric coupling mechanism for railway vehicles—Belfield (*Doyle and Hedley*).
1,452 Overhead conductors of electric railways—Von Kando.
4,233 Electrically driven vehicles—Von Kando.
15,539 Electric railway systems—Hobhouse and others.
17,565 Bogies for railway vehicles—Craddock (*Burn and Company, and Craven*).
17,662 Pneumatic brakes—Chapsal and Saillot.
17,711 Steering axles for motor vehicles—Pittevil and Duquesne.
20,135 Car trucks—Adams.
23,018 Chassis for motor vehicles—Churchill.

1915.

3,358 Railway crossings—East.
489 Means for supporting and joining the ends of railway rails—Arnold.
139 Apparatus for mechanically operating railway points and switches—Gurney.

Colonial and Foreign Tramways Traffic Returns.

NAME OF COMPANY.	1914. WEEKS ENDED. Aug. 1.	Aug. 8.	Aug. 15.	Aug. 2.	1915. WEEKS ENDED. July 31.	Aug. 7.	Aug. 14.	Aug. 21.	AGGREGATE. Wks.	1915.	Increase or Decrease.
	£	£	£	£	£	£	£	£		£	£
Anglo-Argentine	51,035	54,377	52,585	44,691	47,136	51,413	50,848	50,932	33	1,684,807	−135,699
Auckland	20,782	(28 days)	...	...	20,408	(28 days)	...	...	4½	22,153	− 1,158
Burma Rs.	4,340	4,599	4,270	4,156	3,726	3,765	4,021	4,290	...	...	− 949
Calcutta Rs.	68,806	69,317	68,138	67,300	62,717	67,338	68,745	66,538	33	2,188,841	− 99,310
Hong Kong $	11,199	15,106	11,585	10,120	11,938	11,398	11,589	12,207	34	370,296	− 28,747
Madras Rs.	29,911	(14 days)	28,340	...	30,490	(14 days)	30,869	...	32	436,280	+ 171

Companies Issuing Monthly Statements.

	1914. March.	April.	May.	June.	July.	August.	1915. March.	April.	May.	June.	July.	August	Wks.	AGGREGATE. 1915.	+ or −.
	£	£	£	£	£	£	£	£	£	£	£	£		£	£
Brazilian Street Mlrs.	...	...	...	...	...	...	...	...	...	...	...	...	...	—	—
Brazilian Traction Mlrs	6153984	5,941,220	6,180,830	6,188,900	...	...	6294910	6,333,460	6,670,110	6,591,940	...	...	26	37,684,110	+1,239,922
Brisbane	28,325	28,610	29,860	28,590	29,660	...	30,740	29,890	31,780	29,880	31,150	...	31	209,650	+ 10,995
British Columbia $	717,251	698,508	678,314	660,383	690,023	...	557,135	540,861	512,568	498,093	510,723	...	5	510,723	− 179,300
Buenos Aires Pt. & C.	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Buenos Ayres Lacroze	...	...	...	...	43,328	...	...	...	...	...	41,460	...	5	41,460	− 1,868
Cape Town	...	...	...	...	...	...	...	...	...	...	13,960	...	5	13,960	—
Carthagena & Herrerias	2,425	2,069	2,202	1,405	2,416	...	2,436	1,496	1,931	2,059	2,157	...	31	12,805	− 3,407
Cordoba	...	13,406	14,667	13,974	14,165	...	...	13,607	14,458	14,091	14,373	...	18	56,592	+ 317
East India	1,884	1,837	1,885	1,966	2,045	...	1,846	...	2,119	2,194	2,231	...	52	23,784	+ 649
Kalgoorlie	2,476	2,820	3,025	...	...	...	2,638	2,841	3,269	...	...	...	21	13,472	+ 642
La Plata	5,178	4,716	4,727	4,560	...	...	4,582	4,269	4,489	3,876	...	...	26	25,772	− 3,472
Lima	34,665	34,153	33,215	33,499	34,627	...	34,180	31,615	31,700	31,650	33,344	...	31	225,704	− 16,104
Manila $	137,200	134,300	138,600	132,500	...	...	119,984	117,450	120,475	116,875	...	...	26	726,002	− 107,631
Melbourne	63,000	...	...	...	...	...	64,506	...	...	...	...	...	13	186,321	− 9,179
Mexico $	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Montevideo	32,630	29,650	29,016	28,049	26,417	...	29,716	26,786	27,771	24,266	25,161	...	38	251,853	− 31,810
Port Elizabeth	...	...	...	...	...	...	...	...	...	...	3,362	...	5	3,362	—
Puebla $	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Rangoon	6,475	5,367	5,323	4,997	4,975	...	5,217	4,964	4,887	4,997	4,629	...	31	34,374	− 2,935
Toronto $	836,328	830,299	871,733	861,938	866,221	...	820,750	795,816	795,262	787,558	773,013	...	31	5,583,076	− 309,071
Winnipeg $	347,812	337,414	337,664	335,012	346,630	...	303,209	264,856	263,302	255,549	248,022	...	31	2,000,278	− 437,904

(*Continued on page 216*)

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TRAFFIC RETURNS—*continued.*

Tramways and Omnibus Undertakings in the United Kingdom.

NAME OF COMPANY OR CORPORATION.	1914. WEEKS ENDED.				1915. WEEKS ENDED.				AGGREGATE.		
	Aug. 1	Aug. 8	Aug. 15	Aug. 22	July 31	Aug. 7	Aug. 14	Aug. 21	Wks.	1915.	Increase or Decrease.
	£	£	£	£	£	£	£	£		£	£
Aberdeen Corporation ...	2,016	2,052	2,041	1,745	1,884	2,041	1,879	1,905	11	21,323	– 353
Accrington Corporation ...	574	534	561	579	649	633	559	593	20	11,417	– 748
Ayr Corporation	612	522	510	516	628	607	526	654	14	7,185	– 64
Bath Electric	*	...	...	...	...	...	...	...	—	—	—
Birkenhead Corporation ...	1,304	1,333	1,322	1,276	1,459	1,488	1,419	1,428	20½	28,563	+ 1,667
Birmingham Corporation ...	12,286	11,805	10,828	11,128	14,278	15,280	14,396	14,710	21	276,569	+ 18,029
Blackburn Corporation ...	1,341	1,316	1,694	1,623	1,561	1,920	1,308	1,295	21	28,350	– 1,064
Blackpool and Fleetwood ...	1,924	2,500	1,711	1,679	1,586	2,264	2,343	2,004	33	24,453	– 3,200
Blackpool Corporation ...	3,339	5,188	2,670	2,673	2,748	5,075	4,390	4,006	21	39,515	– 5,660
Bolton Corporation ...	2,816	2,742	3,111	2,907	2,887	2,770	2,656	2,819	21	56,026	– 3,900
Bournemouth Corporation ...	3,444	2,551	2,242	2,183	2,926	2,952	2,859	2,985	21	47,732	– 49
Bradford Corporation ...	6,714	6,251	6,483	7,450	7,748	7,415	6,579	7,139	20	138,459	+ 3,079
Brighton Corporation ...	1,488	2,197	1,276	1,276	1,512	1,776	1,577	1,624	21½	24,539	– 1,184
Bristol	10,010	12,088	8,892	8,776	10,179	13,930	10,406	10,279	33½	315,517	+ 26,011
Burnley Corporation ...	1,730	1,570	1,608	1,524	1,663	1,645	1,590	1,570	21	33,756	– 3,021
Burton-on-Trent Corporation ...	329	367	323	307	321	366	312	299	21	6,098	– 388
Bury Corporation	1,350	1,371	1,923	1,560	1,430	1,431	1,445	1,501	20½	29,035	– 1,019
Cardiff Corporation ...	2,883	3,370	2,740	2,763	2,812	3,086	2,908	2,889	20	56,445	– 3,927
Chatham and District ...	985	1,152	1,095	992	1,317	1,628	1,390	1,350	33	38,035	+ 7,150
Chesterfield Corporation ...	381	303	269	262	340	338	279	275	20	5,536	– 311
Colne Corporation... ...	300	251	296	276	321	282	272	279	—	—	—
Cork Electric	516	570	514	554	551	530	560	554	33	16,474	+ 296
Croydon Corporation ...	1,701	2,021	1,667	1,727	1,909	2,480	1,980	...	19	37,131	+ 1,489
Darlington Corporation ...	276	271	261	262	298	316	294	288	20½	5,514	+ 11
Derby Corporation	1,041	1,170	1,155	1,038	1,097	1,294	1,149	1,092	20½	22,063	– 4
Dover Corporation	318	382	278	270	364	438	397	376	20	6,703	+ 1,192
Dublin and Lucan	175	229	157	157	158	219	151	167	7	1,213	– 103
Dublin United	6,191	6,858	6,207	6,309	6,073	7,291	6,215	6,349	33	201,915	+ 5,758
Dundee City	1,382	1,264	1,244	1,237	1,550	1,378	1,333	1,372	13½	18,750	+ 306
East Ham Corporation	1,093	1,260	1,261	1,292	1,330	1,478	1,335	1,395	20⅓	27,531	+ 4,678
Exeter Corporation	406	476	371	356	416	462	449	465	20	8,086	—
Gearless Motor Buses	*	...	...	...	...	...	...	...	—	—	—
Glasgow Corporation	18,140	19,512	20,313	19,775	19,951	21,000	21,416	21,763	12	252,625	+ 14,392
Glossop (Urban Elec. Supply Co.)...	129	126	146	167	141	141	136	138	34	4,154	– 151
Halifax Corporation	2,245	2,434	2,824	3,185	2,415	2,583	2,562	2,571	20	46,532	– 903
Hastings and District	1,309	1,806	1,327	1,243	1,199	1,794	1,621	1,566	33	31,368	– 1,352
Huddersfield Corporation	2,438	2,316	2,599	2,350	2,893	2,993	2,927	2,752	20	56,482	+ 402
Hull Corporation	3,118	3,232	2,927	2,786	3,121	3,376	2,931	2,904	20	62,759	– 3,202
Ilford U.D. Council	565	677	615	638	677	837	688	685	20	13,861	+ 2,305
Ilkeston Corporation	155	119	133	133	171	141	144	145	21	2,836	– 24
Ipswich Corporation	544	664	488	475	668	851	707	663	19	11,775	+ 1,400
Isle of Thanet	1,598	1,937	1,111	1,200	738	1,199	1,042	1,078	46	18,535	– 9,674
Kilmarnock Corporation	254	156	164	155	240	174	160	164	14	2,488	– 46
Lanarkshire	1,537	1,744	1,820	1,945	1,973	2,071	2,103	2,179	33	63,252	+ 161
Lancashire United	1,625	1,859	1,579	1,811	1,919	2,313	1,739	1,811	33	56,862	+ 2,075
Leeds City	8,672	8,665	7,717	8,276	9,465	10,922	8,574	9,401	21	187,297	+ 10,020
Leicester Corporation	2,936	2,991	2,675	2,653	3,169	3,352	3,059	3,117	34	100,274	+ 2,763
Leith Corporation...	789	754	757	711	828	761	774	783	14	11,240	+ 194
Leyton U. D. Council	1,398	1,734	1,476	1,478	1,661	2,063	1,668	1,912	20	33,512	+ 3,997
Liverpool Corporation	14,048	14,493	13,644	13,496	14,421	14,996	13,542	13,848	33	442,231	– 840
Llandudno and Colwyn Bay ...	693	976	472	510	569	805	681	706	38	12,250	+ 582
London County Council	42,235	46,199	43,314	43,353	46,089	49,922	45,178	46,092	20	858,379	– 28,043
London General Omnibus... ...	*	...	...	...	...	...	...	...	—	—	—
London United	*	...	...	...	...	...	...	...	—	—	—
Lowestoft Corporation	442	536	347	309	238	305	284	214	46	8,215	– 1,782
Maidstone Corporation	235	297	219	221	235	309	252	239	20	4,606	– 70
Manchester Corporation	17,159	17,101	17,139	17,021	18,221	18,324	17,693	18,010	20	371,059	+ 2,028
Metropolitan Electric Tramways ...	*	...	...	...	...	...	...	...	—	—	—
National Steam Car	*	...	...	...	...	...	...	...	—	—	—
Nelson Corporation	245	177	204	188	230	196	201	199	20½	4,060	– 398
Newcastle-on-Tyne Corporation ...	5,317	5,390	4,886	4,971	6,633	6,572	6,415	6,524	20	129,881	+ 19,789
Newport (Mon.) Corporation ...	838	1,025	798	800	861	963	881	889	21	17,564	– 388
New St. Helens and District ...	853	1,381	894	964	1,108	1,716	1,093	1,114	7	8,331	+ 1,442
Northampton Corporation... ...	618	714	530	505	773	962	736	711	20	15,751	+ 3,361
Nottingham Corporation	3,484	3,902	3,219	3,287	3,770	4,419	3,663	3,758	20	76,729	+ 3,640
Oldham Corporation	2,241	2,062	2,387	2,232	2,427	2,381	2,324	2,475	22	50,600	– 134
Portsmouth Corporation	*	...	...	...	...	...	...	...	—	—	—
Preston Corporation	872	947	1,191	1,003	998	982	1,082	1,013	20	19,492	+ 21
Provincial...	2,520	3,178	2,287	2,254	2,623	3,235	2,855	2,768	20	99,408	– 9,350
Reading Corporation	724	906	739	705	815	1,023	895	873	20	16,380	+ 1,313
Rhondda Tramways	1,251	1,656	1,142	1,164	1,114	1,242	1,167	1,195	33	38,578	– 2,592
Rochdale Corporation	1,683	924	2,027	2,216	1,944	1,727	1,791	2,002	20½	36,389	+ 1,026
Rotherham Corporation	1,181	1,017	1,053	1,030	1,425	1,216	1,236	1,259	21	24,323	+ 2,516
Salford Corporation	5,116	4,775	5,184	4,670	5,587	5,080	5,136	5,424	20½	109,842	+ 1,045
Sheffield Corporation	7,541	7,407	7,342	7,412	9,126	9,691	9,037	9,326	21⅓	188,512	+ 19,586
Southampton Corporation... ...	1,446	1,814	1,525	1,509	1,519	1,814	1,715	1,649	20	30,313	+ 1,289
Southend-on-Sea Corporation ...	1,444	2,136	1,447	1,462	874	1,796	1,415	1,332	20	18,455	– 5,946
South Metropolitan Tramways ...	*	...	...	...	...	...	...	...	—	—	—
South Shields Corporation ...	881	1,037	818	753	877	1,016	868	872	20½	16,775	– 108
Sunderland Corporation	1,698	2,110	1,720	1,547	1,646	1,948	1,667	1,573	21	31,524	– 1,355
Sunderland District	674	780	...	...	664	813	...	...	40	22,446	– 1,296
Swindon Corporation	169	218	218	225	199	232	222	211	20	4,071	+ 366
Torquay Tramways	819	1,227	780	674	655	811	944	935	33	17,912	– 1,593
Tramways (M.E.T.) Omnibus Co. ...	*	...	...	...	...	...	...	...	—	—	—
Tyneside Tramways and Tramroads	566	769	588	617	659	811	628	678	7	4,747	+ 369
Wallasey Corporation	1,527	1,716	1,476	1,445	1,575	1,885	1,475	1,508	20½	27,876	– 790
Walsall Corporation	631	743	504	665	783	1,026	789	847	34	24,331	+ 3,048
Walthamstow U.D. Council ...	813	1,011	874	939	987	1,246	977	1,191	21	20,069	+ 2,213
Warrington Corporation	433	466	426	419	464	514	459	468	20	9,204	+ 203
West Ham Corporation	2,772	3,099	2,783	2,840	3,108	3,595	3,096	3,476	20	64,088	+ 5,400
Wigan Corporation	1,448	1,612	1,393	1,403	1,578	1,185	1,491	1,514	20	30,791	+ 98
Wolverhampton Corporation ...	1,338	1,003	975	970	1,450	1,144	1,124	1,155	21	23,706	+ 363
Yorkshire (West Riding)	1,512	1,667	1,580	1,438	1,775	2,355	1,608	1,696	34	53,860	+ 3,936

*TRAFFIC RETURNS SUSPENDED.

Owing to the European war, the Government have taken over the railways of Great Britain as from August 4, 1914, and the issue of traffic returns has been suspended. Consequently the traffic returns of the electric railways which usually appear on this page cannot be given.

The Publication of the Traffic Returns of the Tramways marked with an asterisk in the above table have also been suspended during the war.

TRAMWAY DIRECTORIES.

A useful feature of this issue is the directory of electric railways and electric tramways which will be found among the advertising pages. This directory contains the names of the chief officals and the principal particulars relating to each undertaking.

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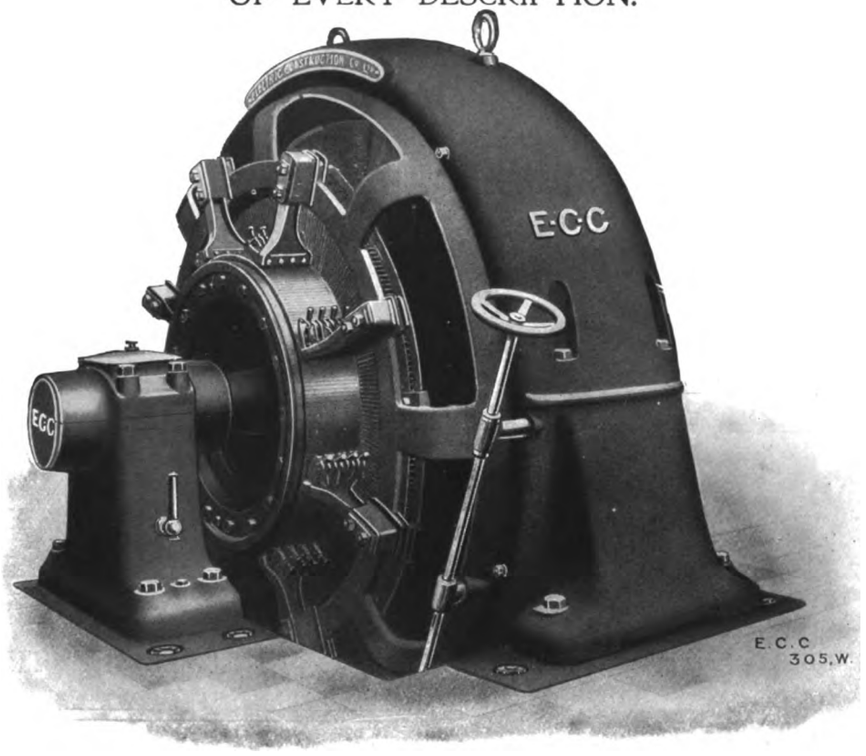

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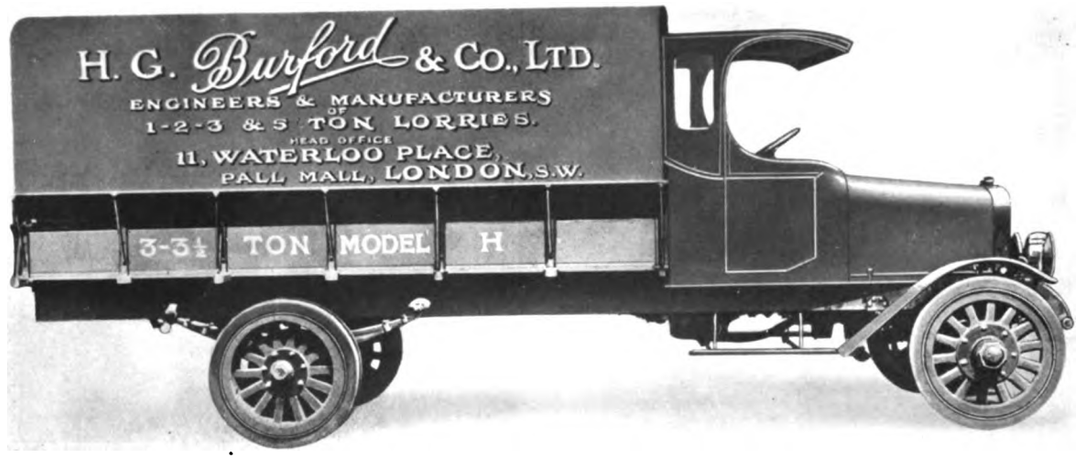

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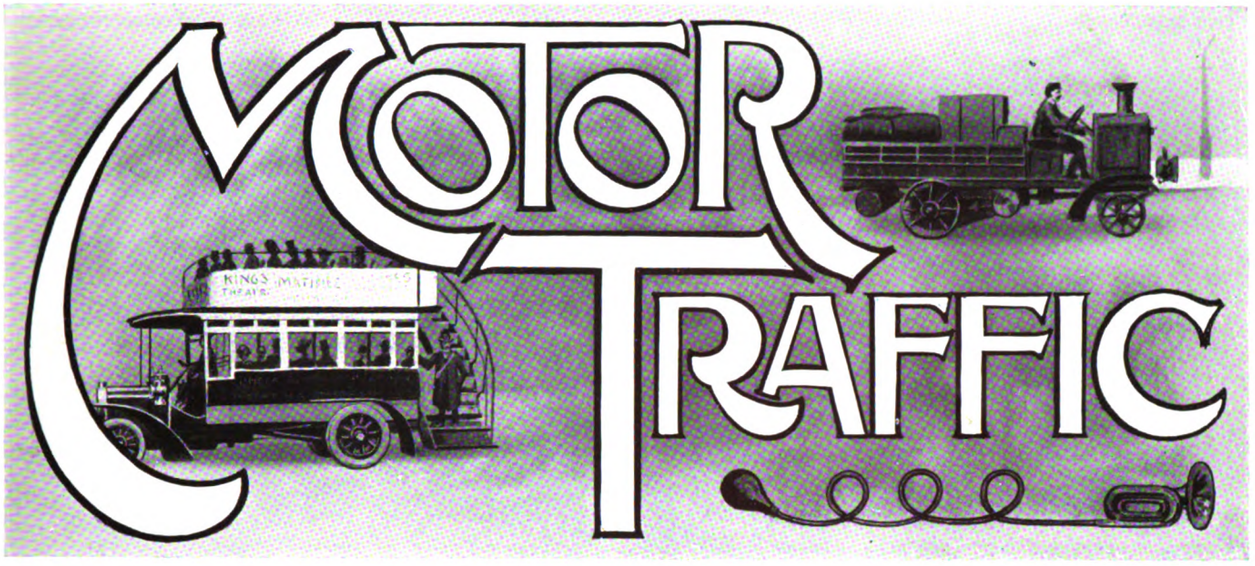

On more than one occasion we have referred in these columns to the difficult position in which British motor manufacturers are placed, owing to the necessity for letting Government contracts take precedence over all normal business. As time goes on, the inevitable consequences of this state of affairs become more and more clear. The British manufacturer, unable to fill orders from his own clients, finds that the Government is taking over from him not only his whole output, but a great part of his goodwill. No blame attaches to anyone in view of this unavoidable circumstance, but the prospects resulting from it are very serious. In the over-seas market the agent who cannot obtain delivery from his principal can hardly be accused of disloyalty if he enters into new arrangements with some foreign firm, so long as the foreigner is able to supply him. In Great Britain itself, a larger share of the business in industrial motors is done direct. Here the principal grievance is not that the agent is alienated, but that the direct purchaser is encouraged to leave a manufacturer who has treated him well, and to begin to build up a fleet by purchases from some foreign maker. Unfortunately the tendency in all such cases, if the first machines prove at all satisfactory, is in the direction of standardisation, which points to the advisability of continuing along the lines on which one has first embarked. Consequently, it is not only the immediate business which is falling out of the hands of the British manufacturer, but what is more serious, the prospective business that should have been done in future years.

* * * * * *

Under these circumstances, British manufacturers have felt the need of binding themselves together in an association, with a view to taking co-operative action. A body, formed some three years ago under the title of the Associated British Motor Manufacturers, Limited, but suffered until now to remain practically dormant, has been resuscitated for this purpose. The intention in the first instance is to endeavour to secure support as unanimous as possible from all British motor manufacturers, including the makers of finished components, with a view to putting the case before the Government and asking for some safeguards. One of the difficulties lies in the fact that any proposal to tax imports is associated in the minds of many people with the propaganda of one political party as against another. Moreover, taxation of imports, unless it were very heavy, could hardly serve the desired purpose. A more promising line of action is, however, to be found in the proposal that imports should be prohibited except in certain specific cases, to meet which licences could be granted free of charge. These licences would provide for the import of vehicles required by the British or allied Governments, and also of industrial vehicles not obtainable within the country, and needed solely for use in essential trades. As the majority of trades now active come under this heading, any scheme of prohibition would not affect the import of industrial vehicles to the same extent as that of touring cars.

* * * * * *

The legislation for which British manufacturers seem likely to ask would in no case be of a permanent character. It would not aim at interfering with fair trade, but at rectifying a state of affairs which it is maintained is obviously unfair. It is to be presumed that even when the war is over, some months must elapse before British manufacturers will be in a position to fill normal demands. This period should be estimated as accurately as possible, and the time of termination of any restrictions pre-arranged accordingly. Without casting any slur upon the merits of American and other foreign lorries and vans, or appearing ungrateful for the assistance which has undoubtedly come to this country from over-seas, it is difficult to deny that the arguments of the British manufacturer briefly outlined above are very strong. The permanent continuance of a strong home manufacturing trade is of great importance to us all, and it would be unpatriotic in the extreme to requite evil for good to our own people, and to reward manufacturers who have exerted their whole energies to provide our armies with mechanical transport, by permanently handicapping them in their struggle for the world's markets.

The fact that motor omnibuses are of great value in military service, whereas tramways, owing to their immobility, are useless except under special circumstances and in limited areas, has necessarily tended towards the temporary reduction in the number of the former vehicles left available for their normal work. It is sincerely to be hoped, however, that local authorities will not henceforth refuse to encourage the motor omnibus on the grounds that, by so doing, their services are liable to be affected in time of war. On the other hand, this fact ought certainly, if it influences them at all, to act as an encouragement to employ a type of vehicle that can be of more than merely local value in emergency. Despite the large number of motor

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MOTOR TRAFFIC.

omnibuses withdrawn from their normal work to meet the needs of the Army, and the fact that the vehicles selected for this purpose have generally been representative of the best available cars in each locality, recent results of local omnibus undertakings have been very satisfactory.

* * * * * *

The Eastbourne Corporation, robbed of its six newest Leyland omnibuses, and thereby made more than ever dependent upon a number of very old omnibuses, has still shown admirable results during its last financial year, ending with March, 1915. The profits, despite the interference with the summer trade of 1914 due to the war, were no less than £760, which is a much larger figure than any previous result showed. The running expenses which, inclusive of heavy capital charges and instalments on new cars, amounted to 14·39d. per mile in 1913, dropped to 12·52d. in 1914 and 12·02d. in 1915. Meanwhile, income rose from 13·38d. per mile in 1914 to 13·46d. per mile during the last year. Running costs, partly owing to the increased price of petrol, went up from about 6½d. to about 7½d. per mile, but repairs and maintenance dropped from 2¾d. to 1¾d. The total of operating costs, exclusive of interest and repayment of loans and instalments on new purchases, is not much in excess of 10d. per mile, and this with a fleet consisting largely of quite old vehicles. The balance sheet of the omnibuses owned by the Sheffield Corporation Tramways, which has been published during the past month, is given in the following pages. It shows traffic expenses, including superintendence, wages, and licences, to be 3d. per mile. Repairs and maintenance work out at just under 2d. per mile, and petrol at nearly 1¾d. per mile. The total of working expenses is 7d. per mile, which, compared with a revenue of nearly 10½d. per mile, leaves nearly 3½d. per mile profit. Of this about 2¾d. goes to depreciation and reserve fund, leaving a comfortable margin. In each of the cases outlined, the results give no cause for complaint, and certainly seem to justify the further extension of motor omnibus services in other quarters as soon as the necessary vehicles become available.

Double-deck motor omnibuses are to be seen to-day working on gradients that a few years ago were a bar to their operation. There is no difficulty now in ascending hills, but the utmost carefulness is required on the part of the driver to bring the machine safely down a descent. It is when a hill is being descended that the double-deck impresses one with the appearance of top-heaviness. Rash driving, or an accident to the man at the wheel, is likely to translate that drawback into an accident. Mishaps have occurred when corners have been rounded at too great a speed. Now that the output of public service vehicles is restricted owing to the needs of the Army, designers might turn their attention to two directions in which it is possible to improve the double-deck vehicle. In the present design there is no means of gaining access to the driver if he is overcome by illness. It is not pleasant to contemplate the number of deaths and injuries that would be inflicted upon pedestrians in a London street if an omnibus thus passed out of control. The remedy is to be found in the provision of the sliding door, as in the case of a tramcar and of some designs of single-deck omnibuses. Another alteration of great importance would be to reduce the height of the chassis, so that the weight of the body can be brought nearer to the track, as is the case with single-deck omnibuses. The body of the double-deck motor conveyance has made no advance in design since the days of the horse omnibus, whereas the single-deck type is to be found in a variety of models. The attractiveness of the latter has added greatly to the popularity of the single-deck vehicle, while not a little of the opposition manifested when a double-deck omnibus runs through a suburb or a country district is due to the huge and unattractive body. The top deck has its advantages for passenger-carrying in fine weather, but these would be further increased if the vehicle were made to present a less dangerous appearance. Unless there are large centres of population to be catered for, the double-deck omnibus is not required for provincial traffic. In most instances the greater carrying capacity of the single-deck machine outweighs the advantages of two decks.

The crude nature of the suggestions made by the Parliamentary War Savings Committee for securing economy in traffic expenditure are likely to result in bringing about greater losses than savings. To effect the desired result action must first be taken by the bodies who are responsible for the organisation of traffic services. The recent attempt made to bring the traffic authorities of London into conference had no connection with the effusions of the Parliamentary War Savings Committee, whose exhortations were addressed to individuals only. Regret must be expressed that so far no indication has been given of any willingness on the part of the omnibus companies of London to respond to the invitation of the County Council to take part in a conference under the auspices of the Local Government Board. It is patent that a considerable saving of the nation's money could be effected by a joint effort to reduce the number of vehicles running. During the slack hours the services both of onnibuses and tramcars are in excess of the public needs, and on the outer terminal mile of one route which we have in mind three omnibuses and a tramcar can be seen running empty time after time for a mile. Doubtless the same spectacle may be witnessed elsewhere. In default of the owners of the vehicles taking action, the war itself will slowly tend to reduce the services through the difficulty of finding traffic hands, and by further enlistments among the men still at work on the cars and omnibuses. Casual observations give one the impression that the omnibus companies' employees have among them the largest number of men eligible for military service, and it is only to be expected that more and more of them will follow the patriotic example of their comrades who have enlisted. That the problem of securing new hands has become acute is shown by the fact that during the last week in August men were being advertised for to train as omnibus drivers and conductors.

BRITISH LEAD IN AERO-MOTORS.—The writer of the motoring and aviation notes in the *Westminster Gazette* states that this country now possesses the most powerful aero-motor in the world. It is the Green, with 12 cylinders, developing 300 H.P. at the low speed of 1,200 revolutions. The Admiralty and the War Office are taking Mr. Gustavus Green's engines as fast as he can produce them. For years he struggled single-handed against official apathy and the resources of the biggest factories in Europe. It remains now to be seen whether the propellor maker can build propellors to withstand the strain of a speed not far short of 200 miles an hour.

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MOTOR TRAFFIC.

DAIMLER AMBULANCE CHASSIS.

Two motor ambulance vans of the type illustrated below have been constructed in the carriage and wagon works of the East Indian Railway at Lillooah for the Government of India, for transport of wounded Indian soldiers in Bombay.

The chassis, with engines complete, have been presented to the Government of India by the Maharaja of Indore and are of the well-known Daimler type, the complete body being built in the works to the design submitted by Mr. C. G. H. Danby, the superintendent, and approved by the military and medical authorities at Fort William. The body is of teak and is divided into a driver's cab and an ambulance compartment. A door fitted between these

Motor Ambulance for Use in Bombay.

allows of communication between the attendant in the car and the driver. The compartment measures 11 ft. 8 in. long, 6 ft. 1 in. wide, by 6 ft. 8 in. high at the sides. It has accommodation for four stretchers, and there are four seats.

SHEFFIELD OMNIBUS RESULTS.

The omnibuses of the Sheffield Corporation Tramways have given quite satisfactory results during the past financial year. The figures are given below, and prove what has so often been said in these pages, that with proper management motor omnibuses can be used with great advantage as an adjunct to a tramway system.

REVENUE ACCOUNT.—Year ended March 25, 1915.

INCOME.			
Receipts from passengers		£16,116	8 6
EXPENDITURE.			
The total working expenses amount to	£10,827 9 9		
Amount set aside for depreciation	1,655 3 6		
		12,482	13 3
The net revenue (or gross profits)		£3,633	15 3
On which are the following charges, viz. :—			
Interest and sinking fund ...	£836 5 2		
Income-tax on profits	105 2 11		
		941	8 1
Leaving a balance on the year's working of ...		£2,692	7 2

DETAILS OF EXPENDITURE.

	Average per mile. d.	£	s.	d.
Traffic Expenses—				
Superintendence	·014	21	10	11
Wages of drivers and conductors ...	2·184	3,362	9	6
Wages of other traffic employees ...	·088	135	9	0
Cleaning and oiling omnibuses	·431	662	14	3
Depot expenses	·049	75	8	5
Ticket check	·064	99	5	3
Uniforms and badges	·118	181	0	11
Miscellaneous—				
Meals for drivers, etc. (£19 11s. 2d.), omnibus licenses (£70 4s.), destination boards, etc. (£8 16s. 1d.)	·064	98	11	3
	3·012	4,636	9	6
General Expenses—				
Salaries of General officers and staff ...	·132	203	3	6
Head office upkeep	·019	29	4	11
Store expenses	·026	40	0	5
Rent, rates, and taxes	·050	77	1	6
Printing, stationery, and advertising ...	·070	107	7	4
Fire insurance	·011	16	7	10
Insurance fund—transferred to meet third party claims	·027	41	11	1
Workmen's Compensation Fund—amount transferred	·012	19	10	0
Employers' contribution to National Insurance	·018	27	12	0
Miscellaneous—disbursements, etc. ...	·005	7	2	6
	·370	569	1	1
Repairs Account—				
Chassis	·844	1,299	6	3
Bodies	·201	308	13	4
Wheels and tires	·786	1,209	13	4
Workshop tools and sundry plant ...	·015	23	1	9
Buildings and fixtures	·043	66	3	8
Miscellaneous	·026	40	7	9
	1·915	2,947	6	1
Road Maintenance Account—				
Sundry authorities—mileage	·055	84	8	8
Power expenses—petrol	1·683	2,590	4	5
Amount of working expenses	7·035	10,827	9	9
Balance carried to net revenue account	3·436	5,288	18	9
	10·471	£16,116	8	6
Net Revenue Account—				
Interest	·241	371	5	10
Sinking fund	·218	334	19	4
	·459	706	5	2
Interest and sinking fund *re* depot accommodation	·084	130	0	0
	·543	836	5	2
Income tax on profits	·068	105	2	11
	·611	941	8	1
Balance carried down	2·825	4,347	10	8
	3·436	£5,288	18	9
Appropriation Account—				
Renewals fund—Depreciation on omnibuses transferred for year	1·076	1,655	3	6
Balance carried to special reserve fund ...	1·749	2,692	7	2
	2·825	£4,347	10	8
RENEWALS FUND.				
Expenditure this year—Accumulators ...	·055	84	7	4
Balance carried to balance sheet	1·930	2,971	11	2
	1·985	£3,055	18	6
SPECIAL RESERVE FUND.				
Expenditure this Year—				
Grant in respect of non-purchase of motor omnibus (Parliamentary Bill, 1914) ...	·032	50	0	0
Balance carried to balance sheet	2·575	3,962	19	11
	2·607	£4,012	19	11

Fares average 1d. for a distance of about 1⅛ miles. The longest omnibus route is 6½ miles.

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MOTOR TRAFFIC.

GUARDS FOR MECHANICALLY PROPELLED VEHICLES.

By H. Conradi, C.E.

A considerable number of accidents are caused to pedestrians by the running of mechanical vehicles. The streets are often narrow, and some, no doubt, are too narrow for the constantly increasing heavy traffic of commercial motor cars, taxi cabs, omnibuses, lorries, private cars, and so on. The streets and roads were not constructed for this heavy traffic, and are not yet quite sufficiently rearranged or reconstructed to bear the weight and the continuity of such traffic.

What has attracted the writer's special attention, however, is the subject of street accidents. *The Times*, in an article of June 18, 1914, drew attention to the request of a shareholder of the London General Omnibus Company that the board of the company should do all they could to reduce the mortality caused by street accidents. The article proceeded :—The dangerous nature of self-propelled traffic in London streets is shown by the following table, giving the latest available figures of fatal and non-fatal accidents, as follows :—

Vehicles.	Accidents. Fatal.		Non-fatal.
	1912.	1913.	1912.
Motor cabs...	40	29	2091
Tramway cars	37	58	2303
Motor omnibuses	167	180	2580
Light motor cars and motor cycles	82	96	3589
Heavy motor cars ...	43	61	376

A return issued by the Home Office in March, 1915, shows that in the year 1914 there was a large increase in the number of accidents resulting in death or personal injury caused by vehicles in the streets in the United Kingdom, the figures for 1914 being 61,670, as compared with 44,643 in 1913. The fatal accidents in 1914 numbered 2,330. In the Metropolitan police district there were 25,876 accidents, 637 of which had fatal results, while in the City of London 1,272 accidents occurred, 19 being fatal. In London, including the City, 3,442 accidents were caused by motor omnibuses, 156 proving fatal ; the City figures being 279 accidents, 8 of which were fatal. In the case of tramcars there were 3,196 accidents, 37 having fatal results. Pedal cycles were the cause of 18 fatal and 5,578 non-fatal accidents.

This number of accidents shows clearly the necessity of a protection against the approach to a mechanically-driven vehicle, and particularly against the approach to the wheels of the vehicle when in motion. The writer's first impression has been that it would be advantageous to have not only a protection against the wheels, but also against the comparatively low car body between the wheels. The real danger zone in the manufacturer's view seems, however, to consist mostly in the open spaces left free in front of the wheels, along the perpendicular tangential line of the wheel's diameter down to the road. Considering the consequences of an accident, the construction of a lifeguard for the protection against the wheels and of the receptacle seat or scoop between the wheels—as indicated in the writer's patent specifications No. 22,788/1912 and in the patent specification No. 6299/1914 (Figs. 1, 2, and 3)—to raise the fallen person out of all probable danger, seems to the writer a more complete protection than the protection of the wheel danger zone only.

Considering the importance of cost, which seems in such a great measure to prevent the adoption of a lifeguard, the writer produced the design of guard indicated in Figs. 4 to 8, as a protection against the approach to the wheels only, supporting it by one or several curved links (4*c*), provided with one or several cavities forming the seats for a shaft or rollers (3*a*) to rest in. These stationary links (4*c*) are fixed to arms (24), which are bent round the wheels and are carried by the arms (23), which are connected to the swivel arrangement of the steering gear, but so that the links are kept at the required distance from the ground and the wheel. In connection with the links, there is suspended and connected with them above the road in front and at some distance from them a protecting shield (16) forming part of the lifeguard, by means of fork-shaped arms (3), which are fixed to this protective shield as indicated in plan in Fig. 7. Into these forks moveable rollers (3*a*) or shafts are inserted, as shown in Figs. 4 and 8, which are made to slide down along the inner surface of the links carrying the shield with it.

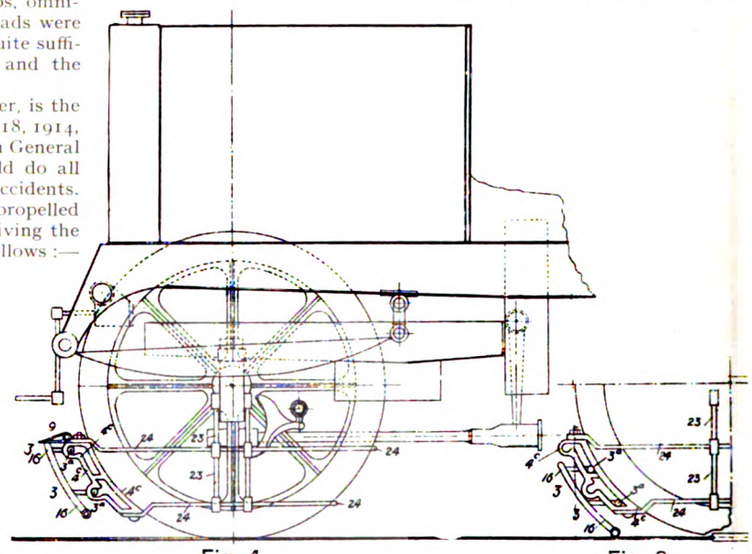

Fig. 4. Fig. 8.

In the case of an accident, the blow against the intervening shield (16) in front of the wheels by the moving vehicle and the falling person, pushes the shield and consequently the rollers or shafts out of their seats, and causes them to slide down instantly along the inner surface of the links, dropping on to the ground and sliding along, assisted by the bottom roller. The approach of the fallen person to the danger zone of the wheel is, therefore, effectively prevented, as indicated in Fig. 8.

The Times, in its article of June 18, 1914, reviewing various apparatus proposed, mentions that the commonest defect exhibited by the devices is that they are made in rigid form, so that the body of a pedestrian struggling on the ground would be jammed. The present writer takes the liberty to contest this opinion, because, if there was not some form of rigidity, the person might, through the blow of the rapidly moving vehicle, become enveloped and kept in a dangerous position along the wheel's danger zone and thus brought into more or less direct contact with the wheels. Further, by the great rapidity with which the protective shield drops, while at the same time its automatic action is similar to the work of an elastic squeegee strong enough and unbending, the guard sweeps the road clean. Besides, the velocity of the car throws the person some distance forward before causing him to touch the ground, making jamming difficult. To facilitate, however, the application of the protective shield and to avoid any possible serious injury to a fallen person through the weight of the downward sliding protective shield (if the supposed jamming in the case of an

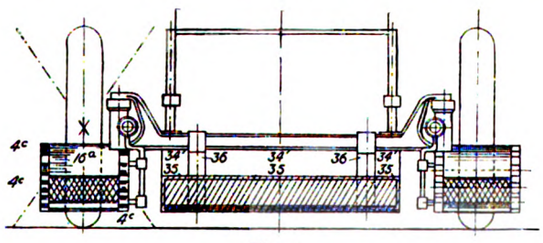

Fig. 1

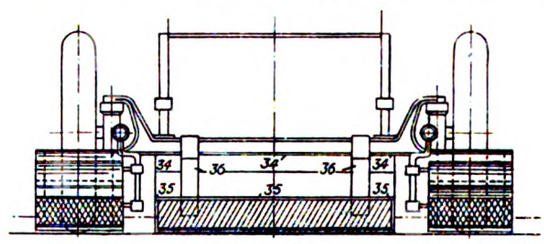

Fig. 2.

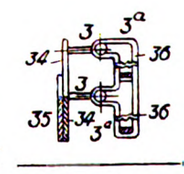

Fig. 3.

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MOTOR TRAFFIC.

accident may in exceptional cases take place), the writer constructs the shield also in two parts, keeping the top part steadily suspended, and letting only the lower part of the shield drop to the ground. This considerably reduces the weight of the dropping shield, and meets the supposition of jamming. The guard being bent forward pushes the fallen person aside.

Fig. 9 represents the side elevation of a motor vehicle, with the modified construction of the links (4c) and the protecting shield (16). The links are constructed with several top and bottom seats for the reception of the rollers or shafts (3a). The top seats or grooves of the links are closed up, to keep the top shafts or rollers suspended in their seats for the ordinary normal course of travelling, as also in the case of an accident, where these rollers are pressed back through the blow of the falling person against the shield, sliding along upon the seats without dropping to the ground. The shield is composed of two parts. The top part (16a) forms a kind of fork, remaining firmly and steadily suspended in its seats in the ordinary course of travel of the motor vehicle, and is not sliding down along the inner surface of the link, nor dropping on to the ground, but is only moving backwards in the case of an accident. It forms at the same time a protecting cover and guide for the other lower part (16b) of the shield itself. This lower part is fitted into the top part of the shield telescopically, so that it can slide down along the inner surface of the top part and drop upon the ground, as required in case of an accident, thus closing up the so-called danger zone, and with it any approach to the wheels. The shield rests suspended in the ordinary way of travel, but is in case of an accident pressed back and its lower part slides down on to the road. The lower part of the shield is constructed to form a netting, to allow any dust or mud to pass through. The bottom part of the shield is constructed preferably of a strong, resisting, not easily pliable, elastic material, as thick india-rubber or leather. Fig. 10 represents the plan indicating a guard in the space between the wheels.

As the approach to this internal space may also be prevented, the writer considers necessary for still greater safety the introduction of a centre guard. It is composed of a frame (34), a protective netting (35), and the links (36) indicated in the front elevations

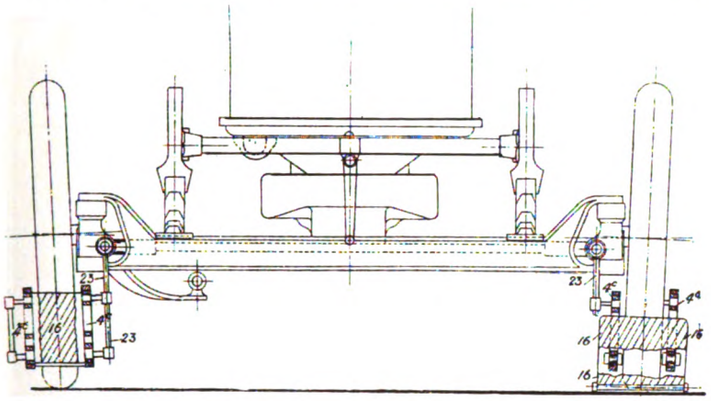

Fig. 5.

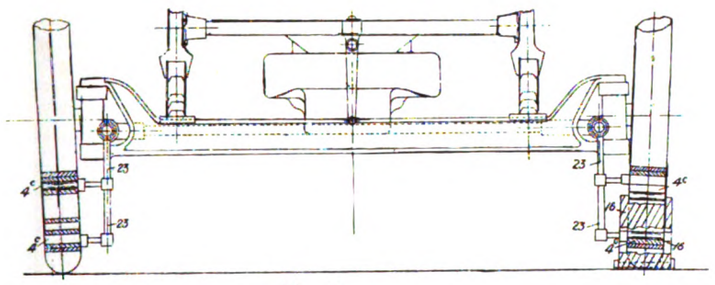

Fig. 6.

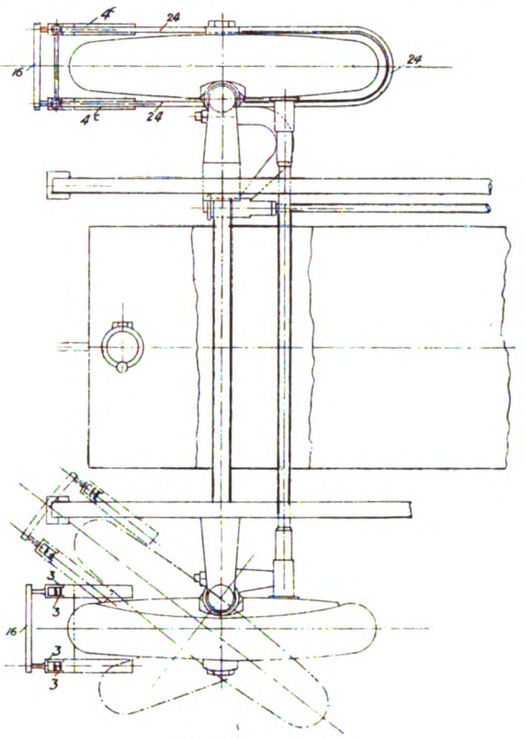

Fig. 7.

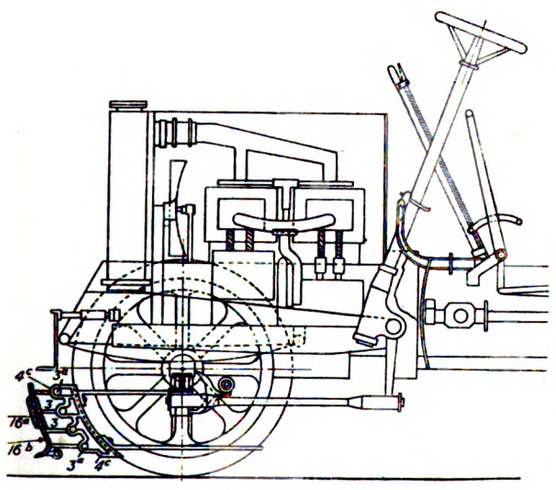

Fig. 9.

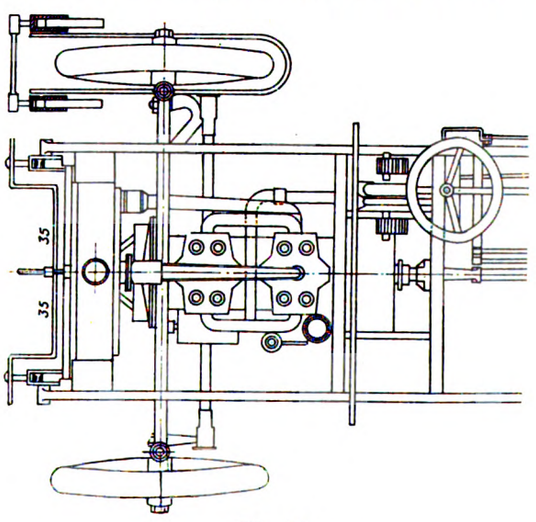

Fig. 10.

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MOTOR TRAFFIC.

Figs. 1 and 2 and in the sectional elevation Fig. 3. The frame with its netting is suspended in the corresponding links (36), which are fixed to the truck frame or chassis or to the fixed wheel axle, as indicated in Fig. 1. It remains suspended in the ordinary course of travel, and according to the general principle applied to the guard, drops to the ground in case of an accident.

Fig. 11 is a side elevation, indicating the links (4c), provided with spiral springs (9a) fixed at the inner end. In case of an accident,

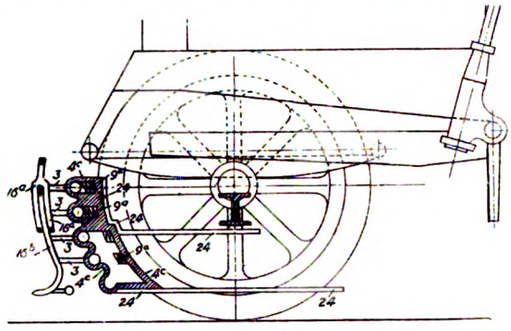


Fig. 11.

the shield and rollers being pressed backwards compress the springs, which, however, expand immediately and assist in pressing the shield, which drops instantaneously on to the road, most rapidly forward, thus preventing the approach to the wheels' danger zone. Fig. 12 is a side elevation indicating the positions of the top and lower part of the shield when acted upon, the inner protective part closing up the approach to the wheels.

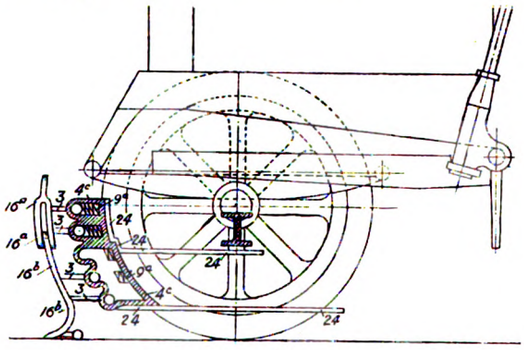


Fig. 12.

To reset the shield in its normal position the writer finds that the shield manufactured in one or in several parts, not being heavy, can preferably be lifted to its normal position by hand. To effect this by lever, from the driver's seat causes a complication of levers, less practical than its resetting by hand.

MOTOR FIRE APPLIANCES.

A Surveyor's Advocacy of Petrol Motors.

At the annual meeting of the Institution of Municipal and County Engineers, held in London, Mr. W. A. Farnham, surveyor to Foo s Crag Urban Council, presented a paper on "Fire Brigade Organisation and Equipment." Dealing with the appliances section of the subject, the author said:—The method of traction should be mechanical. The petrol motor is certainly the most suitable, and it has now reached such a state of reliability as to place it before the horse in this respect, while for both speed in starting and transit the latter is quite outdistanced. It is simple to handle, and no difficulty is found in training the veriest novice in driving.

Twenty-five miles an hour is ample speed; higher may lead to accidents, and is not conducive to reliability; but speed must not be confused with hill-climbing ability. The ideal would be a machine capable of taking a stiff hill without appreciable reduction in speed.

A fire brigade is essentially a life brigade first. No station should be without an escape and hose tender as a first turn-out machine, and the tendency outside the large cities to give the engine the only consideration is to be regretted. In the author's experience, given an average water pressure, this machine will deal with 95 per cent. of the fires, and if provided with chemical extincteurs (of which he prefers two of the 5-gallon portable type to each machine), and provided a call is quickly given and answered, they alone will deal with 75 per cent. of the calls. The escape should be constructed as lightly as is consistent with strength, should be capable of being hand-propelled in a horizontal position, and neither too short nor too long for its purpose; the latter fault is more frequent than the former. A 40 ft. machine is ample for a three-storey building. It should be constructed so that either the whole or part of the ladders can be detached and worked independently if so required.

The motor should also be equipped with the following:—One or two hook ladders, not less than 800 ft. of unlined and 200 ft. of rubber-lined canvas hose of 2¾ in. diameter (the lined lengths for use next the branch pipes to minimise water damage), two standpipes and branches, and the usual minor accessories.

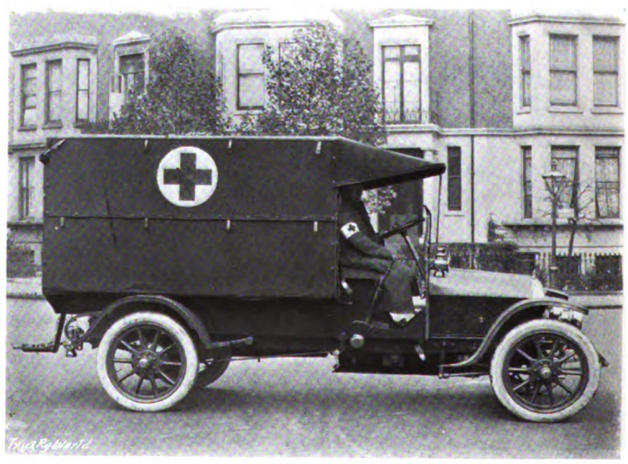
For pumps the petrol motor is easily first. The most suitable type of pump has been a continuous source of controversy, some favouring the reciprocating, others the turbine, or, to give it its more correct name, the high-pressure centrifugal; but it has been principally a makers' agitation, each trying to boom his own particular type. After a lengthy study, Mr. Farnham has come to the conclusion that it is mainly a question of local conditions; each has its advantages under certain circumstances, but that in the majority of cases the advantages are with the turbine.

A more important, but often overlooked, matter is that of capacity, and here again the tendency is to adopt too large a machine. Except in towns possessing rivers, docks, or other similar large sources of water supply, a pump with an output of 220 gallons per minute is ample; it will utilise all the water obtainable from two normal hydrants, and is more easily throttled down where the water supply is limited, as in the case of country fires or small mains. Such a pump can be driven by an engine of 35 B.H.P., and this power will be ample for traction purposes. This machine should also carry 1,000 ft. of 2¾ in. canvas hose, as well as the usual minor accessories, and a light ladder extending to, say, 30 ft. is a most useful appliance.

The two most important items to ensure a quick turn-out were (1) all motors should be equipped with either a self-starter, or, alternatively, with accumulator and coil ignition attached through duplicate plugs to each cylinder, in addition to the magneto, as even the best of these latter are liable to be slow on a cold night; (2) the lamps should be of an instantaneous lighting type, either from an electric self-lighting set from the accumulators supplying the secondary ignition, or from dissolved acetylene cylinders. Small portable, self-contained acetylene lamps should be provided as a stand-by.

BRITISH RED CROSS AMBULANCE.

The motor ambulance illustrated below is one of several hundred cars which Messrs. Brown, Hughes, and Strachan, Limited, have constructed since the beginning of the war, to meet the requirements of the British Red Cross Society. This particular car was supplied



to Mr. Stodhert. In many instances these cars are driven in the service of the Society by their owners, and in other cases by paid drivers employed by the Society. In most cases they are equipped to carry four stretchers, which are rigidly secured, the upper ones to shelves and the lower ones to the floor. The drivers are well protected from weather, and the whole arrangement combines simplicity and economy with strength.

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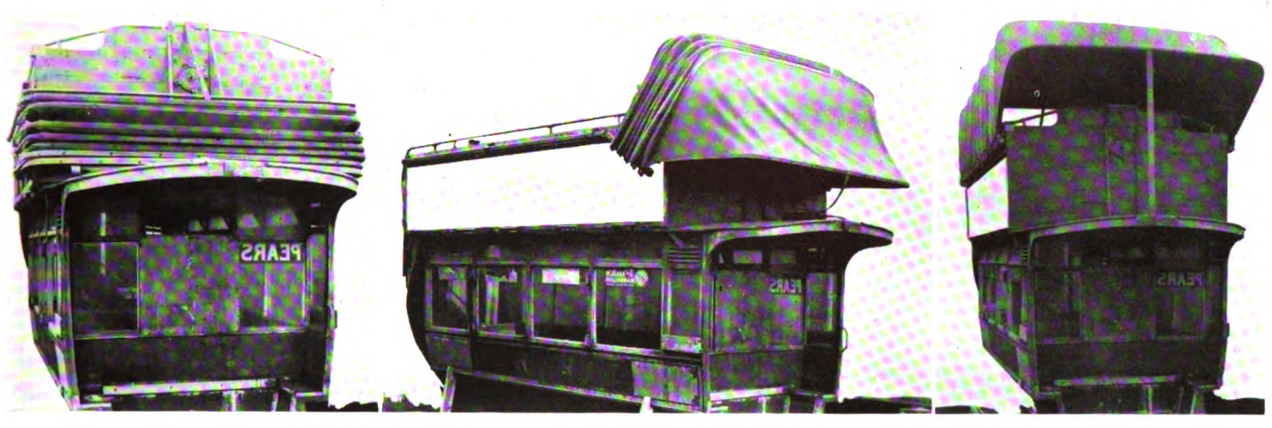
MOTOR TRAFFIC.

A HOOD FOR MOTOR OMNIBUSES.

A collapsible hood has been patented for the double-deck motor omnibus, as also for chars-a-bancs and wagons, by Mr. F. Beck, Willesden Paper and Canvas Works, Willesden Junction. It can be fitted to any existing omnibus without alteration of the vehicle, and when not in use the hood rests over the driver's canopy. When the hood is open the appearance of the omnibus possibly is not improved, but that objection may be outweighed by its utility in enabling passengers to sit in comfort on the top deck in wet weather.



Probably greater difficulty will be experienced in overcoming the objection that when folded the hood seems to interfere with the use of the space behind for indicating the route of the omnibus. On the long distances traversed by the London vehicles many places are named on the boards. On provincial routes the objection would not be so apparent.

MOTOR VEHICLES FOR MUNICIPALITIES.

Manchester Corporation have ordered a motor prison van.

Chatham Council are obtaining a steam tractor and two trailers.

Newmarket Council are about to obtain prices for a steam tractor.

Portsmouth Council have decided to purchase a Dennis fire engine at £990.

Kensington Council have received delivery of a third Laffly motor sweeping machine.

Wallsend Council have received sanction to borrow £1,100 for a motor fire tender and pump.

Ashton-under-Lyne Council propose to obtain a motor fire engine at the conclusion of the war.

Newport (Mon.) Council have accepted delivery of a motor fire engine from Messrs. J. Morris and Sons.

York Council have asked the city engineer to obtain particulars of the cost of motor street sweeping machines.

Gateshead Council have received sanction to borrow £1,100 for the purchase of a motor fire tender and pump.

Preston Corporation expect delivery of a second motor fire engine by Messrs. Merryweather and Sons early in November.

Rochdale Council have called for a report from the sanitary works manager on the question of purchasing an additional motor wagon.

Lancashire County Council have been recommended by the Road Committee to purchase four small cars at a cost of £870, to replace the small cycle cars that have been in use for three years.

Hertfordshire Council have purchased a Ford car at £175, for the use of the tuberculosis officer and the health visitor. It was at first decided to buy an English car for £250, but the Public Health Committee found that it could not be obtained.

Sydney Council have placed a contract with the Australian General Electric Company to fit up the municipal power station with the apparatus needed for charging the batteries of electric vehicles. Tenders have been issued for the supply of electric lorries to the Council.

Southampton Corporation electrical engineer has obtained tenders for the batteries required for fitting up the chassis of an electrical vehicle. This will be the fourth electric vehicle in the service of the municipality, and it will be chiefly used for work connected with the laying of mains.

Durham County Council have placed orders as appended:—Steam tractors, Messrs. Aveling and Porter and Messrs. Burrell and Sons, at £604 12s. and £595 respectively; four tractor wagons, Messrs. Tasker and Company, £96 10s. 0d. each; two from the Bristol Wagon Company, £87 10s. each.

Chester Corporation have agreed to purchase three electric vans for refuse collection. The vehicles will be supplied by Edison Accumulators, Limited, through Messrs. Drake and Gorham, Limited, and payment will be spread over four years. A saving of £124 per annum is anticipated, as compared with the present horse vehicles.

Sheffield Council have purchased the following motor vehicles: For the Electric Supply Committee—Two-ton Chase lorry, £592 from Yorkshire Motor Company, Limited; second-hand Belsize car, £175. Health Committee—Second-hand Mass car, £160, from the Dart Motor and Transport Company, Limited, in lieu of a Ford car.

Nottinghamshire County Council have been recommended by the Highways Committee to purchase a steam tractor, at £800. Increasing difficulty has been experienced in obtaining horses, and the cost of horse haulage worked out at an average of 10½d. to 10¾d. per ton per mile. In other counties the average price of steam tractor haulage per ton per mile did not exceed 5d., while in some instances it was less than 4d.

Worcester Council recently considered a recommendation by the Electricity Committee for the purchase of a 3-ton battery lorry with tipping body from Edison Accumulators, Limited, at a cost of £941. The proposal is part of a scheme by which the committee hope to effect a saving of £1,250 annually in the works costs. As other committees are contemplating the adoption of motor haulage, the Council deferred a decision until their recommendations have been submitted.

Dover Corporation have put into operation two of the six two-ton electric dust vans ordered from the Edison Accumulators, Limited. When the vans enter a street notice is given to the occupiers of houses by the sounding of an electric hooter, by means of which device much time will be saved. It is expected that the six vans will effect a saving at the rate of £1,400 per annum on the horse wagons. The latter have entailed an outlay of £7,000 a year. It is estimated that the running costs of an electric vehicle will not exceed £178 per annum.

Blackpool Corporation have taken delivery of an electric street watering vehicle from the General Electric Company. It has a speed of ten miles an hour and the tank holds 750 gallons. In his annual report the borough surveyor states that the Laffley motor sweeper has given great satisfaction, and to a large extent he attributes to it the reduction of the cost of street cleansing from £7,447 to £6,340. He gives the working cost of the machine per hour as being about 2s. 9d., including 7d. per hour for the driver, 10d. for petrol, and 1s. 4d. for repairs, cleaning, etc.

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MOTOR TRAFFIC.

MOTOR TRAFFIC NOTES.

ROTHERHAM TRAMWAYS COMMITTEE have provided a motor omnibus service between Aston and Rotherham on Mondays and Saturdays.

OXFORD TRAMWAYS COMPANY have issued an attractive booklet describing country walks accessible from their various motor omnibus termini.

NEW SERVICE FROM BIRMINGHAM.—The Corporation Tramways Department are inaugurating a motor omnibus service between Handsworth tramway terminus and Aston.

PLEASURE TRIP FROM ABERDEEN.—At a charge of 5s. 6d. return, the Aberdeen Suburban Tramways Company are running on Sundays one of their petrol-electric omnibuses from King's Statue to Ballater.

AUSTRIA SHORT OF SOLID RUBBER TIRES.—Reuter's correspondent at Zurich states that the Vienna municipality being unable to obtain rubber tires, is replacing motor omnibuses by horse vehicles, which on account of the shortage of horses can only run at 12-minute intervals.

FOUR COUNTIES LINKED BY OMNIBUSES.—As the result of the motor omnibus service just started by the British Automobile Traction Company between Altrincham and Cheadle, the four counties of Staffordshire, Derbyshire, Cheshire, and Lancashire are now linked up by motor services.

MOTOR BOATS FOR THE EASTERN CONFLICTS.—A number of motor boats for towing barges and other work have been sent to the British Forces operating at Gallipoli and in the Persian Gulf. The Red Cross Society, 83, Pall Mall, London, S.W., are receiving funds for the provision of additional boats.

ROAD RECONSTRUCTION AT OXFORD.—At a cost of over £34,000, the Corporation have decided to reconstruct a considerable stretch of road surface to render it suitable for motor omnibus traffic. Included in the work is about a quarter of the mileage of the horse tramways, which are not now used, motor omnibuses having replaced them.

OMNIBUSES TO BE MADE IN SYDNEY. Before the end of the year the Motorbus Services, Limited, Sydney, intend to place 20 motor omnibuses on such streets as the local authority may approve of. The vehicles will have a six-cylinder engine of 55 H.P. Some of them will be of United States manufacture, but it is intended to make the remainder in Australia.

ECONOMISING IN PETROL.—In order to save petrol the route of the Coppice omnibus, run in connection with Oldham tramways, has been shortened at each end. It now stops at the post office in Union Street instead of mounting the Greaves Street hill to the Town Hall. Twopennyworth of petrol is expended each time the vehicle is taken up the hill, which was climbed twice every hour in a 14-hour day.

MOTOR-DRIVEN OPERATING THEATRE.—Victorian State Railway employees have presented to the Victorian Defence Department a vehicle that is claimed to be the first motor-driven travelling operating theatre in the world. Its cost was £1,500, and it was accompanied by a motor kitchen (£400) and three ambulances (£1,400). The kitchen can cook for 250 men. The gifts are for the use of the Victorian troops.

THREATENED ACTION FOR ROAD DAMAGE.—Abingdon Rural Council have resolved to enter upon the hopeless task of proceeding against Oxford Electric Tramways, Limited, to recover compensation for damage done to roads by the frequent motor omnibus service from Oxford to Abingdon. Malling Rural Council, however, have taken the more cautious step of seeking counsel's opinion upon a claim that they propose to make against the company.

LONDON OMNIBUS ENTERPRISE.—The management of the London General Omnibus Company have issued a 16-page folder, with coloured illustrations, setting forth the country excursions that can be made by motor omnibus. Hatfield, St. Albans, Watford, Epsom, Dorking, Reigate, Windsor, Hadley Woods, and South Harrow are amongst the services. The fares are as attractive as the places visited, and it only needs for the publication to be placed in the hands of the public to secure widespread patronage.

WHERE TRAMWAYS AND OMNIBUSES COMBINE.—Bristol Tramways and Carriage Company, Limited, have issued their quarterly time table and map of tramway car and motor omnibus services. The combined services traverse all the main thoroughfares of the city and penetrate into every suburb, and by means of the omnibuses the surrounding country for upwards of 20 miles is connected to the city by frequent services. Many picturesque places are thus brought within easy reach of the citizens. There are over 30 route miles of tramways, and over 100 miles of omnibus routes.

PRAISE FOR MOTOR WORKS EMPLOYEES.—Dennis Brothers (1913), Limited, write that it must not be supposed that British working men are all oblivious to the interests of the country. Their works are fully engaged on Government contract orders, and the men have supported the Company most loyally in executing the very large Government demands, the bulk of which have been for vehicles of the subvention model. At the same time the company have been privileged to construct a certain number of fire engines. Every pay-day the men take out a large number of vouchers for the new war loan.

TRAFFIC RIVALRY IN CROYDON.—Mr. T. B. Goodyear, general manager, Croydon Corporation Tramways, in a recent report mentions that in the June quarter last year there were 90 London omnibuses plying in and beyond the borough on weekdays, and 155 on Sundays. In the September quarter the numbers were 95 and 146; December quarter, 70 and 100; March quarter, 60 and 80. The decrease is due to the impressment of vehicles for war service. There was a net balance of £190 on the 1914-15 tramways accounts, a decrease of £1,171. The decrease is attributed to an estimated loss of £3,839 in traffic revenue and to £1,974 paid to dependents of enlisted employees.

MOTOR VEHICLES REQUIRED FOR BOMBAY.—The Bombay Post Office have placed a contract with the Mahableshwar Motor Service Company, Limited, for the conveyance of the post-bags about the city. Over 100 trips a day will be made, apart from the carriage of the English mails to and from the landing place to the Post Office and the railway stations. If a sufficient number of vehicles can be secured, the new service will start on October 1. The company require six 1½ ton vans for the heavy work and six 5 cwt. machines for the light loads, and four other vehicles as a reserve. For several years the company have carried the mails and passengers to and from Wathar and Mahableshwar.

METROPOLITAN ASYLUM AMBULANCES.—Thirteen new motor vehicles (one 16-passenger omnibus and 12 ambulances) were brought into use during the year 1914 by the Metropolitan Asylums Board, which is concerned with the removal of infectious hospital and lunatic asylum patients. During the same period 15 horse-drawn ambulances were sold, also a small motor omnibus. Two old motor ambulances were converted into small omnibuses. On the outbreak of the war three motor ambulances were sold to the War Office for £1,161. The removals last year exceeded 80,000. The board also gave assistance in the transport of sick and wounded soldiers and sailors sent for treatment in hospitals in London and its neighbourhood.

TRAILERS AND THE MILEAGE GUARANTEE ON SOLID RUBBER TIRES.—Considerable attention is now being given to the use of trailers attached to heavy motor vehicles, and in this connection the fact is very often overlooked that the attaching of a trailer to a rubber-tired motor vehicle very seriously affects the life of those rubber tires. The committee of Solid Rubber Tire Manufacturers (M.A.A.) calls attention to the following clause in the standard form of mileage guarantee, which deals specially with solid rubber tires used under such conditions:—"The above guarantee (i.e., the standard 10,000 miles' guarantee) shall not apply to the tires on any vehicle to which a trailer is attached, and the attaching of a trailer will be held to cancel any guarantee which may have been given. A limited and reduced guarantee (not exceeding 7,000 miles) may under suitable conditions be specially arranged."

WAR AND MOTOR COMPETITION.

A meeting of representatives of a number of leading British motor manufacturers who are members of the Associated British Manufacturers, Limited, was held on Thursday, August 12, under the presidency of Mr. Edward Manville, chairman of the Daimler Company. It was stated officially after the meeting, which was private, that these manufacturers contemplate approaching the Government concerning the complete engagement of the great majority of British motor manufacturers on Government work and their inability, owing to that fact, to meet foreign competition on fair terms so far as normal trade is concerned. Membership of the society is open to any British manufacturer, and Mr. Horace Wyatt has been appointed secretary, with offices at 173, Fleet Street, E.C. Mr. Wyatt explained that there was still a considerable trade in private and commercial cars which was being captured mainly by American makers. The British manufacturers, after struggling hard for years and finally establishing themselves in a leading position in the trade, were now steadily losing way. It was not merely a temporary matter. It might take years to recover their position after the conclusion of the war unless the matter was tackled now.

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THE Tramway & Railway World
WITH MOTOR TRAFFIC SECTION

Founded 1892. LONDON, OCTOBER 14, 1915. VOL. XXXVIII.

TRAILER CARS ON THE LONDON COUNTY COUNCIL TRAMWAYS.

Through the courtesy of Mr. A. L. C. Fell, chief officer of the London County Council Tramways, we are enabled to present a description and drawings of the new trailer cars which are being brought into use with highly satisfactory results on the South London lines of the County Council's undertaking. By the use of these vehicles, London is setting an example to most of the other large towns, but it must be admitted that in London the need for trailers is probably greater than in any other part of the country.

In the earlier days of electric traction, trailer cars were used to a limited extent in a few English towns, but their employment did not spread, partly no doubt because of the difficulty in getting the consent of the Board of Trade. As time went on, however, the need of trailer cars to cope with the traffic during the busy hours of the morning and evening became more urgent. In some towns this "rush hour" traffic became almost overwhelming, and this was particularly the case in London.

In the year 1912 we dealt on several occasions with the advantages to be obtained from the use of trailer cars. In the issue of February 8 of that year we published a number of letters from managers and engineers of American street railway companies on the advantages of trailer cars. In the issues of April 4 and May 9 following, we gave letters received from many of the important tramway undertakings on the continent of Europe, where the use of trailer cars had been developed to an enormous extent. It was shown that the use of such cars was not only economical, but helped to get over the "rush hour" difficulty and caused much less street congestion than if a corresponding number of single cars was used.

Notwithstanding the favourable experience abroad, the Parliamentary Bill of the London County Council, promoted in 1912 for the purpose of enabling the Council to run trailer cars, was strongly opposed by the Metropolitan Police. So good a case was, however, made out that Parliament sanctioned the scheme, so

Fig. 1.—Motor Car and Trailer on Victoria Embankment, London.

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far as the Council's tramways south of the Thames and along the Victoria Embankment were concerned. The northern lines were left to be dealt with separately later. This year the Council sought Parliamentary authority to use trailers on the northern lines also, but withdrew the proposal pending further experience on the southern lines.

Within a year of the passing of the Council's Act of 1912 some half a dozen trailer cars were put on the southern lines. These consisted of old horse cars reconstructed and modified. So satisfactory did the trailers prove that early last year the County Council gave an order for 150 trailer cars of an improved design. Owing to circumstances arising out of the war, delivery has been slower than had been expected, but a number of the new cars have recently been received and are now in service. As time goes on the number will increase. The fact that only three men—one driver and two conductors—are needed for a two-car train, as compared with two drivers and two conductors for two separate cars, is an additional advantage in these days, when so many of the uniformed staff have gone to the war. The other advantages which have already been mentioned, as well as the small current consumption and small wear of rails caused by the comparatively light trailer car, are of course permanent benefits, irrespective of whether employees are scarce or plentiful.

The new trailer cars are of the double-deck type without roof covers, and seating accommodation is provided for 18 passengers inside and 30 passengers outside. Cross seats are provided both inside the car and on the upper deck. The following are the leading dimensions :—

Length over the couplings ..	28 ft. 10 in.
Length over the spring fenders	27 ft. 2 in.
Length of body	15 ft. 6 in.
Width over guard rails.. ..	6 ft. 10 in.
Extreme height	13 ft. 2 in.
Height from rail level to floor of upper deck	9 ft.
Height inside the car	6 ft. $2\frac{3}{4}$ in.

These cars are not mounted on trucks in the ordinary way, but are carried direct on the axle boxes through laminated springs in a manner similar to that adopted in railway practice. The wheel base is 6 ft. 9 in. Standard wheels and axles are used and the Council's standard parts and fittings are employed wherever possible.

The under framework seen in Fig. 3 is used solely for the purpose of supporting the brake gear, life-guard, etc. It consists of light rolled steel sections braced together by cross members and stiffened with angle irons and plates where required. This framework is made as light as possible, consistent with strength. Non-poisonous paints and varnishes are used throughout.

Special Features.

Amongst the special features of these cars the following will be of interest :—

As will be seen from the illustrations, the platform and staircase have been so arranged as to allow passengers to mount or to alight from the car at either end, and, if necessary, on either side.

Four drop lights are fitted on each side of the car, each of which is provided with two spring clip holders and engaging racks to allow of the windows being firmly locked at any point. Rubber wearing blocks are fitted to the window frames to prevent rattling. Brass hand lifters are fitted to the centre of each bottom rail. In addition to these windows, ordinary side ventilators are fitted.

It will be noticed that the cars have been designed with straight sides, instead of with the usual waist and rocker panels, and finished with half-lapped and "V" jointed casing boards 2 in. in width. The object of this form of construction is to provide more room inside the cars.

The car is illuminated electrically through a special plug connection with the tractor car. This connection is fitted on the canopy roof at the rear of the canopy rail. An oil tail lamp is also provided at each end of the car to comply with the police regulations.

In the new trailer cars ball bearings have been introduced owing to the reduction in tractive effort required in hauling the cars, which careful experiments had shown to result therefrom. The type adopted is the "Skefko" ball bearing. This is a double ball bearing, and the inner face of the outer ball race is machined and ground to a radius struck from the centre of the bearing. The inner race is provided with two grooves, having a radius slightly larger than the radius of the balls employed. This arrangement ensures that under ordinary conditions the bearing is self-aligning. The diameter of the balls is $1\frac{5}{16}$ in.

Both the balls and the bearing as a whole are somewhat larger than the ordinary type of ball bearing. This feature, however, enables them to withstand the shocks and hard wear and tear met with in actual practice, which have, as a rule, been detrimental in ordinary ball bearings adopted in tramway work.

The reduction in starting effort due to the use of these bearings will be seen in results of experiments made in London and set out in the following table :—

	Trailer Car with Ball Bearings.				Trailer Car with Ordinary Bearings.			
	Tons.	Cwts.	Qrs.	Lbs.	Tons.	Cwts.	Qrs.	Lbs.
Weight of cars (loaded for experiment) ...	7	18	2	14	7	1	1	14
Pull required to start car*	0	0	0	135	0	0	0	270
Starting pull in lbs. per ton	0	0	0	17·02	0	0	0	38·3

* Average of 25 pulls taken in each case.

Special Equipment.

Where trailer cars are used, special attention has to be given to three important items in the equipment, namely :—(*a*) Brakes, (*b*) couplings, (*c*) collapsible gates. The equipment provided on the new cars is the outcome of careful experiment and experience, and the following notes briefly describe the designs which have been adopted :—

(*a*) *Brakes.*—An automatic brake has been specially developed for these trailer cars. The brakes used are applied to the wheels through a system of levers by means of very powerful springs. When the tractor begins to move it pulls on the drawbar of the trailer and gradually releases the pressure of the brake blocks from the wheels, so that as long as the tractor is in motion the brake shoes are off the wheels, but immediately the tractor ceases to pull the trailer the brakes on the trailer cars are applied. The operations of stopping and starting are performed very smoothly, and the brake is so adjusted as not to skid the wheels.

To explain this action a little further. When the two cars are at rest, the brake blocks (which are fixed so as to operate on the inside of the four wheels) are held against the wheel treads by two powerful springs, which are always in a state of compression. The action of the drawbar relieves a certain amount of this pressure, and, under normal conditions of operation,

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the braking effort varies in the inverse ratio to the drawbar pull, and as the drawbar pull increases, the braking effort decreases. It is therefore evident that if the coupling for any reason fail and the two cars become separated, the brake will at once stop the trailer, the pressure applied to the wheel blocks by the springs being so graduated as to prevent the car running back on the severest gradients.

The operation of the brake is as follows :—The drawbar pull is transmitted through the medium of chain (A, Fig. 3), working in a hollow sleeve (B) ; the pull is transmitted over a quadrant and drum to a rocking shaft (C), carried on the sub-truck at the back of the headstock, and in order to obtain double purchase on the chain, it is taken round a pulley fixed on the end of the main pull rod (D). This in its turn is coupled to an ordinary floating sway bar, equalising chain and link arrangement to the brake shoe beam. As far as possible the brake details are of the Council's standard design for electric cars.

It will be noticed from the illustration that the links (F) are connected to the brake shoe beam by means of two adjustable bolts, and to allow of equal pressure on all four wheels, these are connected to the brake beams by trunnions (G).

As already mentioned, the two brake beams have the pressure applied through two powerful springs (H), enclosed in malleable cast-iron spring boxes. These boxes consist of a cylinder and plunger, which are arranged to work one inside the other, and the relative position of the two portions is a measure of the pressure applied. Two index plates are fixed to each side of the cylinder (capable of being read from both the outside and inside of the truck), and calibrated to read the pressure within defined limits.

The initial pressure is fixed at the commencement of operation and kept adjusted to the required figure as the brake blocks and wheels wear down.

It is necessary under certain circumstances to release this brake, and special arrangements are made for this purpose. On the platform a slot is provided and through this slot an ordinary point lever can be inserted in the socket (K) shown in the illustration. This socket forms part of a lever which is connected through a chain to the first motion shaft (C). One man can easily release the brake. The point lever cannot, however, be removed until the brake is on.

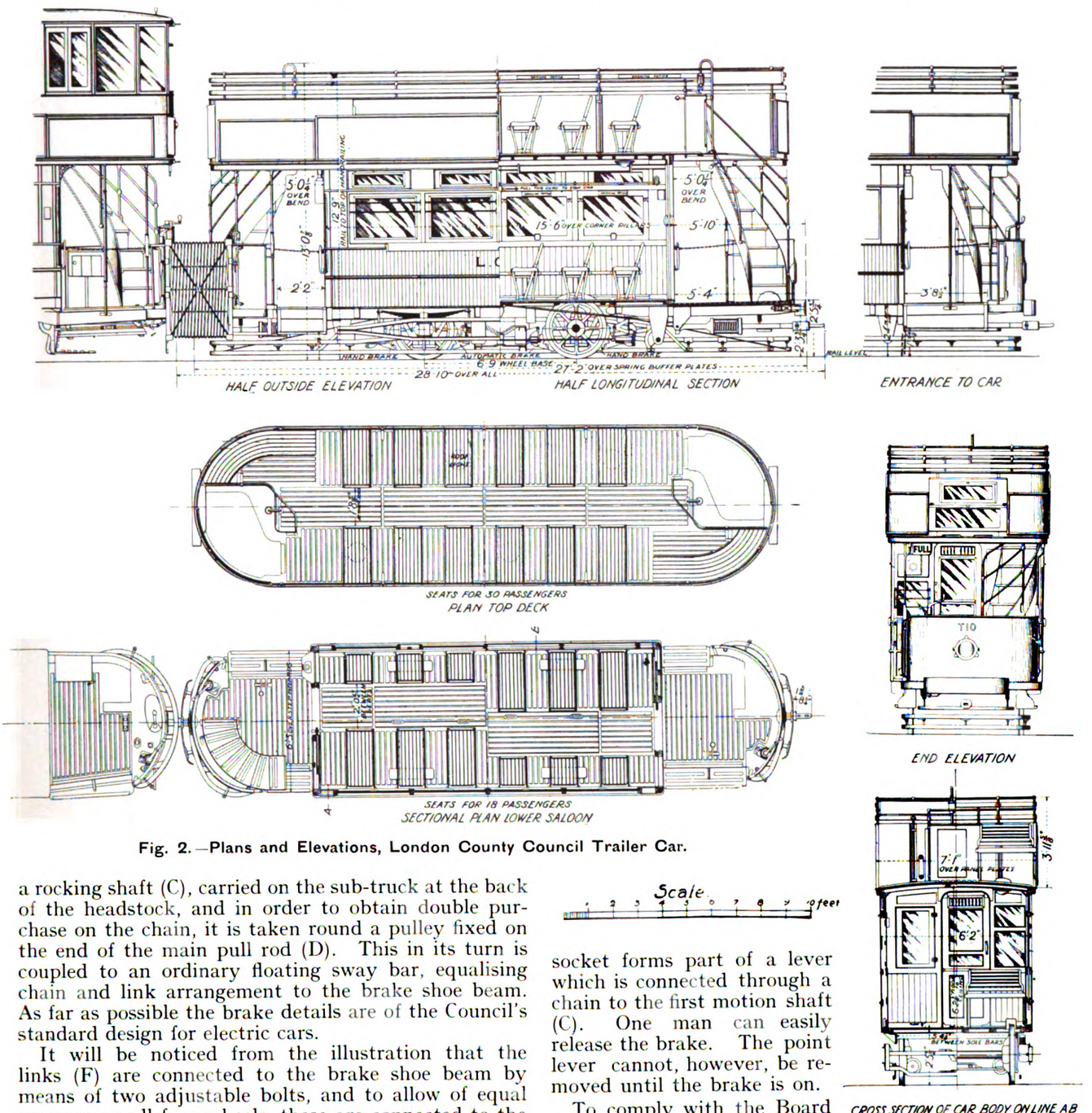

Fig. 2.—Plans and Elevations, London County Council Trailer Car.

To comply with the Board of Trade regulations, an ordinary hand brake is provided and four auxiliary brake blocks are fitted to the outside of the wheels, these being operated in the ordinary way by means of a standard hand brake arrangement.

(*b*) *Automatic Couplings.*—Owing to the different conditions of operation, the types of automatic couplings

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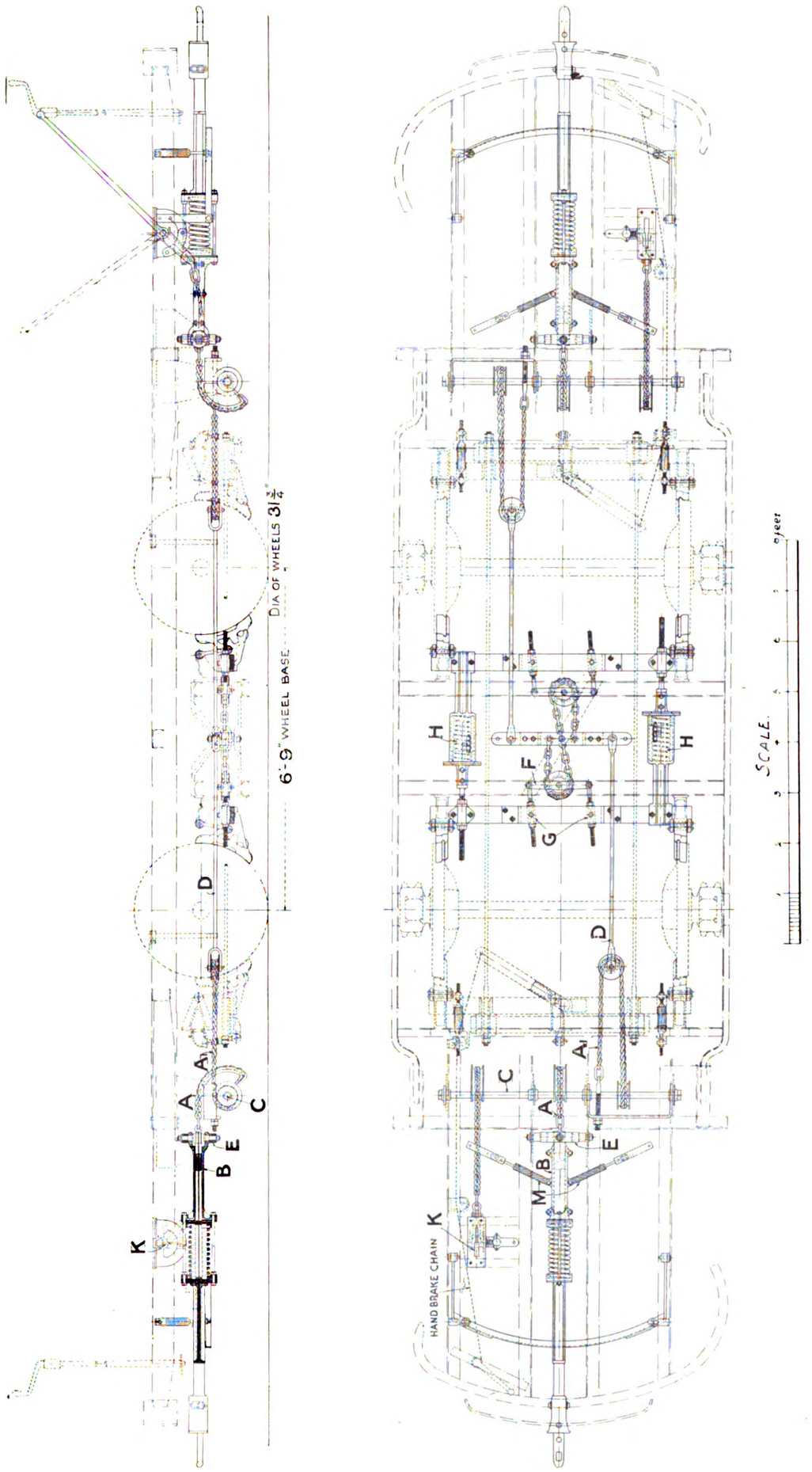

Fig. 3.—PLAN AND ELEVATION OF TRAILER CAR, LONDON COUNTY COUNCIL TRAMWAYS.

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used in railway work are unsuitable for tramway purposes. In tramway working provision must be made for the following conditions :—

1. The coupling must not interfere with the free operation of the lifeguard and gate on the tractor.
2. No portion of the coupling must project beyond the buffers of the tractor.
3. Owing to the possibility of having different loads on the tractor and trailer, and the consequent difference in spring load, the coupling must accommodate itself to any difference in level, oscillation, or wear of wheels.
4. In order that the coupling and uncoupling of cars may be expeditiously performed, the coupler should be simple, thoroughly reliable in operation, and should possess the fewest possible wearing parts.

These conditions have been met by a special design of the A.B.C. coupler.

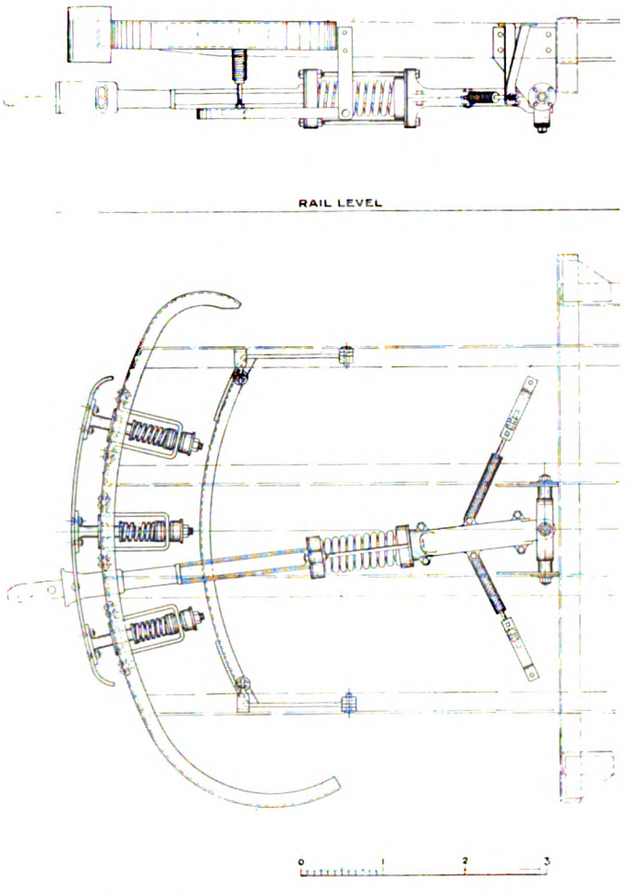

Fig. 4.—Arrangement of Buffer and Coupling Gear.

The operation of this coupler is as follows :—It will be seen from Fig. 5 that the coupler is made in two portions. The trailer portion contains a shackle (A), which engages with a disc hook (D), which revolves in the portion fixed to the tractor. The shackle causes the disc hook to revolve. The disc hook is revolved into a locked position, while a spring actuates the locking bar (F), which enters the slot in the disc hook and maintains it in that position.

To uncouple the cars it is only necessary to push or pull the locking bar (F) when the latch (E) in the disc hoop (D) will fall and thus hold the locking bar (F) in the uncoupled position, and as the tractor moves away the disc hook (D) is automatically turned into the position ready for coupling again.

(c) *Collapsible Gates.*—Portable collapsible side protection gates constructed of seasoned ash and stiffened by diagonal springs are supplied to each car. They are provided with substantially formed hooks at each end for the purpose of supporting them in position between the tractor and the trailer car by means of lugs on the platform stanchions. These gates are necessary to prevent anyone falling or endeavouring to pass between the tractor and the trailer car. The varying positions of the tractor and trailer, when passing round curves, render it necessary for these gates to be collapsible.

The type of gate now adopted is the outcome of actual experience with trailer cars in London. The first type of gate was the telescopic pattern used in many places on the Continent. It was found, however, that the telescopic pattern seized in going round sharp curves, and as many breakages resulted, this pattern was abandoned.

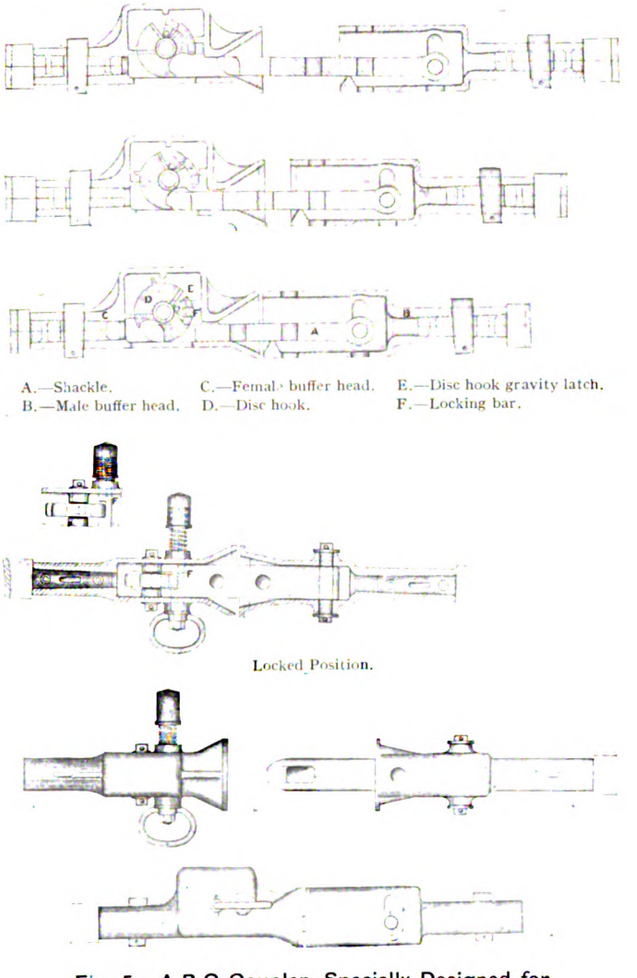

Fig. 5.—A B C Coupler, Specially Designed for L.C.C. Trailer Cars.

Signalling.—Special attention had necessarily to be given to the arrangement of signalling between the two conductors and the driver of the tractor. On the London County Council Tramways the conductor of the trailer signals to the conductor of the tractor by means of the ordinary signal bell and the latter in turn signals in the same way to the driver. The conductor of the trailer car is also provided with a special whistle, differing in sound from those generally in use, so that if he happens to be on the top of the car no confusion will arise in the mind of the driver.

Melbourne Cable Tramways.—In introducing the "Greater Melbourne" Bill in the Victorian Legislature, the Premier said that one of its chief functions was the control of tramway and lighting services. The electrification of the whole of the tramway services was but a matter of time, and this world necessitate the supply of a large amount of current.

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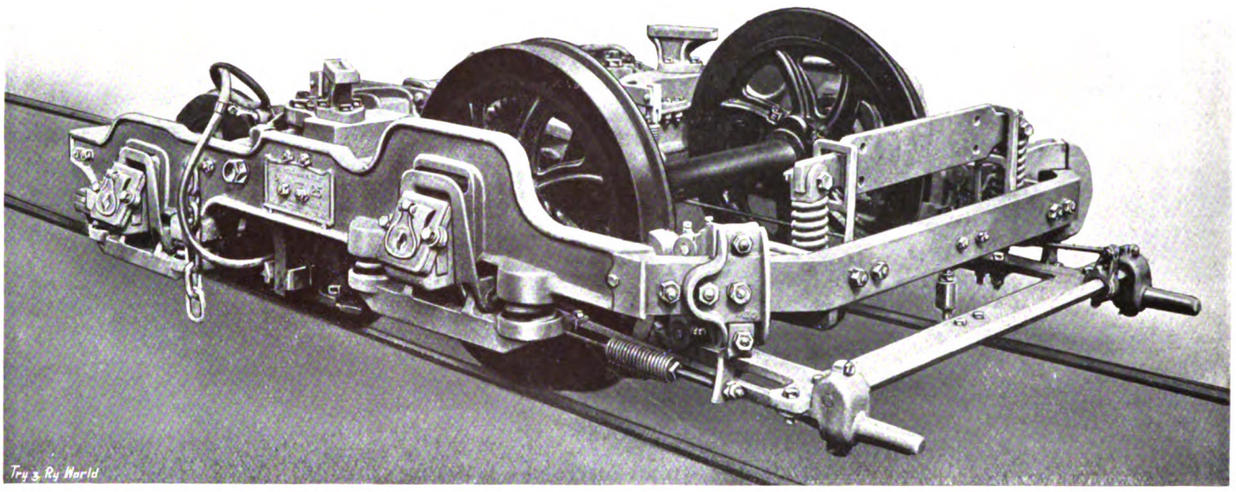
A NEW FEATURE IN MAXIMUM TRACTION TRUCKS.

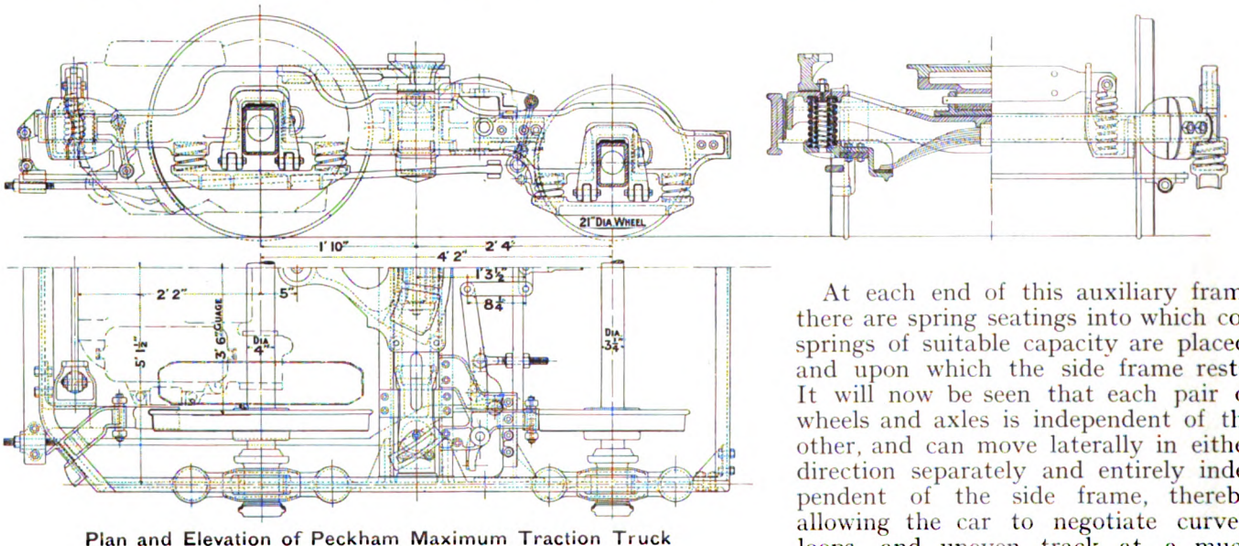
The Peckham Truck and Engineering Company, Limited (the original inventors and makers of a flexible axle single truck), have now completed with very satisfactory results some severe tests with their pendulum gear fitted to maximum traction trucks. This truck was designed to overcome several objections that



Peckham Maximum Traction Truck with Pendulum Gear.

managers had to using this type of truck, i.e., excessive wear of the wheels and rails, screeching on curves, and excessive current consumption, and also to give a better riding car under all conditions, and it is claimed that this truck has succeeded in doing all this satisfactorily.

The truck has several novel features, and is claimed to be a great improvement upon the swing bolster or side bearing types, which, although they relieve the car body to some extent on curves, etc., do not relieve the wheels and axles, motors, etc., of the side shocks. It will be seen from the illustrations that the truck is constructed of side frames made from best open hearth steel, all in one piece, and connected together by means of cross members of rolled steel bars, all bolts being a driving fit.



Plan and Elevation of Peckham Maximum Traction Truck with Pendulum Gear.

The usual body bolster is fitted and is connected to the car body in the usual manner by means of segmental plates with machined surfaces properly lubricated, and is also provided with side bearings which are radiused to allow for the movement of the body; but it has only a vertical movement, the usual swing links being dispensed with. It is provided with a double set of spiral and elliptic springs which are regulated in combination with the axle box springs to produce an easy and smooth riding car under all conditions, whether empty or loaded. The pendulum gears are fitted at each end of both the driving and pony axles, and consist of a steel saddle or swing link suspended in spherical grooves from the top of the axle boxes, and are connected at the bottom fork ends to an auxiliary supporting frame by means of case-hardened pins of an ample diameter.

At each end of this auxiliary frame there are spring seatings into which coil springs of suitable capacity are placed, and upon which the side frame rests. It will now be seen that each pair of wheels and axles is independent of the other, and can move laterally in either direction separately and entirely independent of the side frame, thereby allowing the car to negotiate curves, loops, and uneven track at a much greater speed than heretofore, without fear of derailment. The heavy blows to the various parts of the truck and car body are thus eliminated.

The motor suspension is of a special design to allow for the lateral movement of the wheels and axles, and is so constructed that there are no rattling parts, however long the trucks are in service. The axle boxes are designed to allow ample room for either oil or grease lubrication, and are provided with the patent

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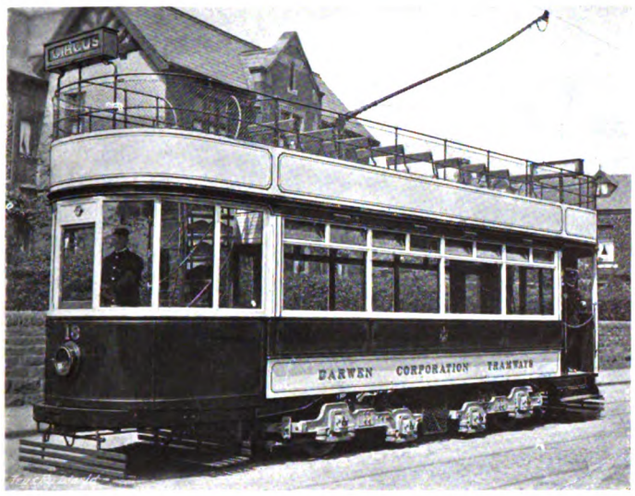
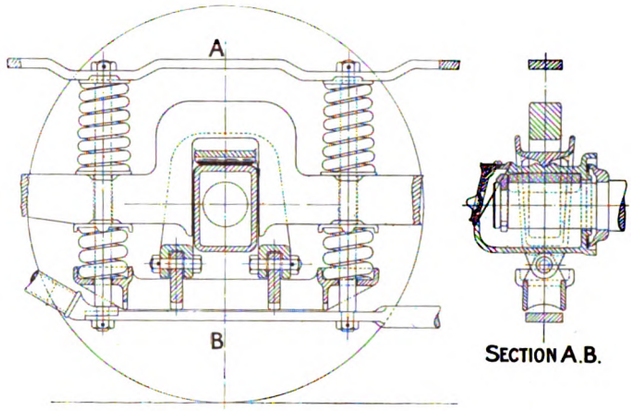
inspection cap on the front covers, which allows the boxes to be inspected and oiled without removing the front covers. They are also provided with their patent automatic dust guard at the back, which retains the oil and does not allow the dust to get into the boxes. The brake gear is of the compensating type, and



Car Mounted on Peckham Maximum Traction Truck.

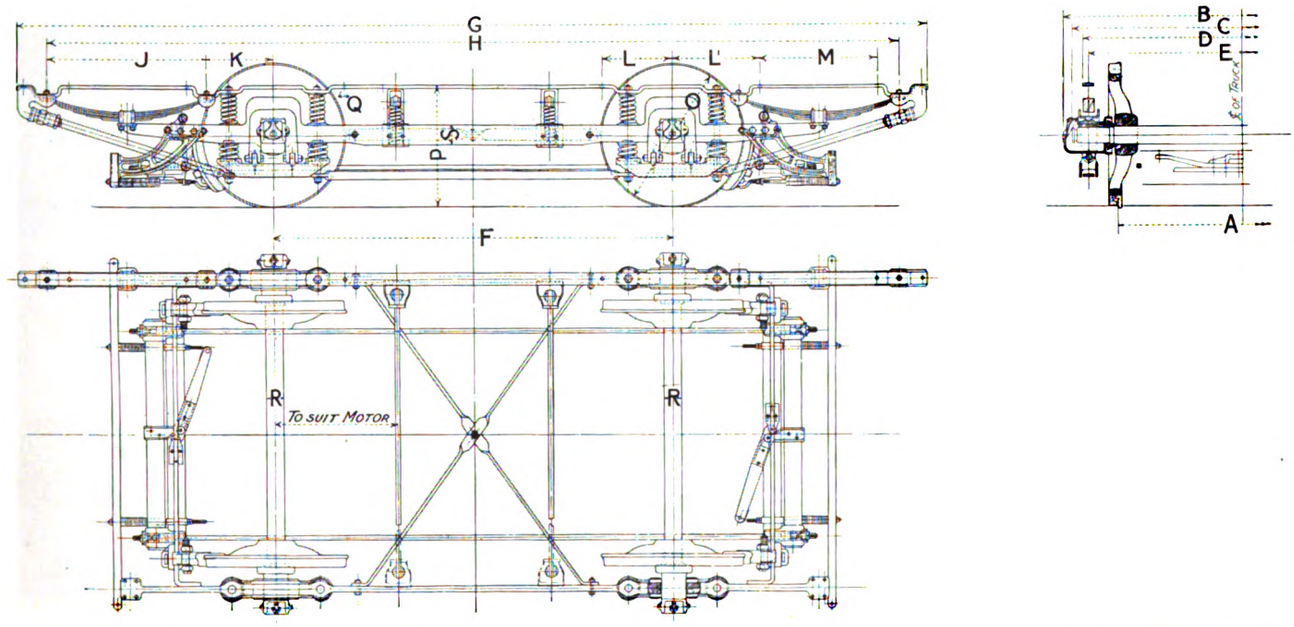
designed to be used in conjunction with magnetic track brakes if desired, and allows the correct percentage of pressure to be applied to the driving and pony wheels.

another, and can move in such a manner as to allow curves and points to be negotiated at a much greater speed than heretofore on rigid axle trucks. (3) That there are less renewable parts, thereby reducing the maintenance cost considerably. (4) That there is a great saving in current consumption.



Pendulum Gear of Single Truck.

The pendulum gears are well known to most of the tramway managers, and are now in use and applied to four-wheel trucks on over 30 tramways in this country and abroad. They have proved to be very satisfactory



		Metre.									
		ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
A	Wheel Gauge ...	3 0	3 3½	3 6	4 0	4 8½	5 0	5 2½	5 3		
B	Width over Journal Boxes	6 0¼	6 1⅜	6 4⅜	6 10⅞	7 0	7 2⅜	7 5⅜	7 5⅜		
C	Length of Axles (Check Plate Type) ...	5 5⅜	5 6½	5 9⅜	6 3⅜	6 5	6 7½	6 10½	6 10½		
D	Width over Sole Bars	5 0¼	5 1⅜	5 4⅜	5 10¼	6 0	6 2⅜	6 5⅜	6 5⅜		
E	Centres of „ „	4 10	4 10⅜	5 2	5 8¼	5 9½	5 11⅜	6 2⅜	6 2⅜		

		ft. in.	ft. in.	ft. in.	ft. in.	ft. in.
G	Total Length (with 36-in. Semi-elliptic Spring)	16 0	16 6	17 0	17 6	18 0
H	Spring Base „ „ „	15 6	16 0	16 6	17 0	17 6
F	Wheel Base	7 0	7 6	8 0	8 6	9 0
O	Diameter of Wheels	—	—	30	33	34
P	Height of Truck (Car Body empty) ...	—	—	26½	29½	30½

Plan and Elevation of Peckham Single Truck with Pendulum Gear.

The special advantages claimed by them for this truck are :—(1) That the pendulum gears not only relieve the car body, but also relieve the wheels, axles, motors, etc., from all side shocks and blows, thereby giving a much longer life to all parts. (2) That each pair of wheels and axles are independent of one under all conditions owing to their simple construction, there being very few wearing parts.

As will be seen from the illustrations, this gear can be fitted to any type of four-wheel truck at a very little cost, and does not necessitate any alteration to the truck frames, etc. All that is necessary is to remove

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the old boxes and substitute the Peckham pendulum gear, the new boxes being designed to suit the existing bearings, check plates, etc., and can be converted in a few hours.

It will be found that this gear will greatly improve the riding of the car, as the increased spring support not only prevents galloping of the car but in effect increases the wheel base of the truck 1 ft., and owing to the flexibility of the wheels and axles would permit the wheel base to be increased at least 1 ft. 6 in. without affecting the current consumption per car-mile.

The Peckham Truck and Engineering Company, Limited, of 32, Broadway, Westminster, London, S.W., will be pleased to send to any of our readers one of their illustrated catalogues, which shows a large selection of car bodies mounted upon their P-22 pendulum and R-24 radial geared trucks, which we understand are all giving satisfaction.

ELECTRIFICATION AND TRAIN DELAYS.

It is very encouraging to hear of the small number of delays in the electric trains in the vicinity of New York. The American *Railway Electrical Engineer* quotes figures from a report of the Public Service Commission for the year ended June 30, 1915, that show that out of a total of 67,080 trains, 93 per cent. of them arrived at their destination "on time," which, however, appears to mean that they were not more than five minutes behind schedule time. In the district concerned there are several electrified railroad divisions, and all of these made an admirable record for promptness. Of these, the road having the least number of delays was the New York, Westchester and Boston R.R. In twelve months, out of 74,551 trains, 99·2 per cent. of them arrived on time, so it cannot be said that it is an exceptional record for a period of fortunate operation, but is the average performance over the period of a year. Of the 625 trains that arrived late, the average number of minutes lost per train was only 0·093. In the analysis of the causes for these delays, the significant fact is that in more than 77 per cent. of the cases the delays were due to waiting for trains on other lines, a condition for which the railroad is not responsible and over which it has no control. Of the total delays, only about 1½ per cent. were due to the equipment. This is said to be due in a large measure to the careful inspection that the electrical equipment undergoes at regular intervals; it speaks well for the reliability of the modern electric locomotive. The records of the other electrified divisions in this district, the Hudson and Harlem divisions of the New York Central and the New York, New Haven and Hartford, were well above the average.

Volunteer Car Workers at Newcastle.—The general manager reported to the Tramways Committee on September 30 that with the aid of 75 volunteer motormen and conductors the early morning and evening car services had been greatly increased. In June the morning service was run by a minimum of 98 cars and a maximum of 107, whereas there was now a minimum of 130 and a maximum of 138. For the evening service, in June there was a minimum of 40, and a maximum of 47. There was now a minimum of 55 and a maximum of 59. Forty members of the Volunteer Training Corps had acted as motormen and conductors, 11 others were in training, 11 members of the clerical staff of the tramways department had given like assistance, and 13 ex-motormen and conductors who were at other employment, but had early morning hours to spare, had been similarly engaged.

Electric Tramway for Cuba.—The *Gaceta Official* (Havana) of July 16 publishes a Decree, dated July 7, authorising the Havana Electric Railway Light and Power Company to construct a new double-track electric tramway in that city. Work must be commenced within a year, and completed within two years, from the date of the promulgation of the Decree.

SOUTHPORT TOURIST CARS.

Since the appointment of Mr. T. J. Kendrew as general manager of Southport Corporation Tramways Department, the working of the undertaking has shown a great improvement. For the past year the financial result gave the first net profit recorded for six years. One factor towards the latter change has been the institution of a grand tour section, which secures a large amount of patronage that otherwise would not be attracted to the tramways. In its own sphere this new service has withstood the attractions provided by private motor chars-a-banc tours in the surrounding districts. The route was instituted in April, 1914, and it proved so successful that four toast-rack or observation cars were purchased out of the revenue. In his report for the year ended March 31, 1915, Mr. Kendrew states that the cars during their first season produced a revenue of £1,569, which averaged 29·434d. per car-mile. Their earnings would have been considerably more if the war had not interfered with the summer traffic last year.

It will no doubt be found that the more economical running of the tourist cars, and also the saving of power due to fewer stops being necessary, have contributed towards the decreased consumption of electricity which is recorded for the year 1914-15. Although 12,438 more miles were run the units used decreased by 3,313

Southport Cross-Bench Tourist Car.

The extra mileage was occasioned by the grand tour section. If the same rate of current consumption has been maintained as in the year ended March 31, 1913, the expenses under this heading would have been £586 higher. Mr. Kendrew points out that if the Tramways Committee were charged in accordance with the new scheme of charges for electricity, adopted by the Council on March 10, 1914, there would be a saving of about £1,000 per annum. The question of the charges for electrical energy to this committee was recently considered by the Council, and the chairman of the Electricity Committee promised the matter should receive favourable consideration in the near future.

The accompanying illustration of the Southport car shows that it is very similar to the type that has met with so much success on Blackpool Corporation Tramways. It was constructed by the United Electric Car Company, of Preston, the Southport body being carried on a single truck instead of bogies. While the Blackpool car has fourteen reversible seats, the Southport type has eight reversible and two stationary. We learn that the Wellington (N.Z.) Tramways is not the only undertaking operating double-deck cars with open sides to the lower deck. A few years ago the United Electric Car Company constructed for the Blackpool, Lytham, and St. Anne's Tramways Company several top seat cars with the lower decks open at the sides and with cross seats.

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LONDON AND SOUTH WESTERN RAILWAY ELECTRIC LINES.

The commencement of electric service on the suburban lines of the London and South-Western Railway has again been delayed, but it is hoped that during the present month the new trains may begin to run. A brief general description of the installation was given in our issue of September 9, and a complete account with illustrations of the principal features will be published in our next illustrated number. This change to electric traction will greatly benefit suburban travellers, and it will undoubtedly much increase the receipts of the company, although the existing fares will not be altered. Between Waterloo and Wimbledon there will be practically a five minutes' service throughout the day, while trains between Waterloo and Kingston will be run at ten minute intervals. Travellers over longer distances will also derive advantages from the new arrangements, because many trains to and from Guildford and Portsmouth will no longer stop at Wimbledon. As the three-car trains are provided with four motors, aggregating 1,100 H.P., there will be ample power, and both the acceleration and running speed should be greatly in excess of those to which London suburban travellers have been accustomed. The compartment system has been retained in the new trains, which are exceedingly comfortable, and it will be surprising if the new service does not rapidly become popular. It will at any rate be the most striking improvement effected in the suburban service of any of the great railways having termini in London which has been effected in many years.

RAILWAY ELECTRIFICATION.

Manchester to Bury Electrification.

The conversion of the railway between Manchester (Victoria Station) and Bury, *via* Prestwich, to electric working on the third-rail system, is expected to reach completion in November. Power will be obtained from Manchester Corporation until the power-house at Clifton Junction is completed. Corridor carriages will be provided similar to those on the Liverpool-Southport electric line.

Melbourne Suburban Railways.

In connection with the recent decease of Mr. F. Renwick, who in 1903 retired from the position of engineer-in-chief of construction to the Victorian Government Railways, it is stated that after his resignation the question of the electrification of the Melbourne suburban lines came to the front. He submitted evidence which showed a wide and intimate knowledge of the subject, and gave an approximate estimate of the cost which for accuracy in the later light of Mr. Merz's detailed estimate has surprised all who have had to deal with this subject.

Electric Locomotives on the North Eastern Railway.

The first installation of electric locomotives for heavy freight traction in this country is about to be brought into operation on the Shildon and Newport line, near Middlesbrough. This section serves the West Durham coalfield, the output of which has an unrestricted run to the steel and iron works between Thornaby and Middlesbrough. Ten locomotives will be engaged in the traffic, and they have been constructed at the Darlington works to the design of Mr. Vincent Raven, the chief mechanical engineer. Each has two overhead current collectors. Mr. C. A. Harrison, the late chief engineer to the company, designed the electrical equipment of the line. The results of this system of traction, if confirmatory of those in the United States, will lead to extensive developments. For some years the North Eastern Company have operated two small electric locomotives from Newcastle quay to Trafalgar sidings.

All-Steel Cars in View of Electrification.

The Erie Railroad has recently placed in service a train of eight suburban passenger cars of all-steel construction. While they are built for steam operation, provision has been made for the ultimate addition of electric motive power equipment. Thus the height and outline of the roof will permit of application of overhead current collector if required, the arrangement of vestibule for application of platform control equipment, the arrangement of underframes for the support of electrical motive power equipment, and the design of draft sills, bolster and truck whereby clearance is provided for electric motors. In the arrangement of the superstructure all parts contribute to its strength to withstand shocks of derailment, overturning, or collision. Each coach is 70 ft. 4 in. long over all, weighs complete 95,400 lb., and has 86 seats. The total weight is less than that of two classes of steel underframe cars which seat only 72 persons each, the weights in these cases being 96,500 lb. and 100,500 lb. Designed by Mr. L. B. Stillwell, consulting engineer, New York, the new cars were built by the Pressed Steel Car Company, Pittsburg.

Chicago, Milwaukee, and St. Paul Railway.

Plans have been completed for the conversion of the first portion of the Chicago, Milwaukee, and St. Paul Railway to electric working, and by the beginning of 1918 it is expected that 440 miles of this railway from Harlowton (Montana) to Avery (Idaho) will be operated electrically. The plans provide for the supply of three-phase current at 100,000 volts and 60 cycles by the Montana Power Company, to be converted to continuous current at 3,000 volts for the overhead line, the sub-stations to be 35 miles apart. Each locomotive will weigh about 260 tons, and will have a continuous rating of 3,000 H.P. This rating, according to the *General Electric Review*, exceeds that of any existing steam or electric locomotive.

Michigan 2,400-Volt, Third-Rail Line.

The first 2,400-volt, third-rail line constructed has been opened by the Michigan Railway, which is to operate it for the Commonwealth Power Railway and Light Company, Grand Rapids. It comprises 50 miles of track between Kalamazoo and Grand Rapids which has been constructed for speeds up to 90 miles per hour, while the remaining 44 miles of steam road were purchased from the Michigan Central Railroad, and runs between Allegan and Battle Creek. Infrequent steam service or none at all was the chief reason for the construction of the new 50-mile line, which connects three towns whose populations have increased to 125,000, 40,000, and 30,000 respectively. To develop the passenger, freight, and express traffic between the three points three classes of train service have been inaugurated, including one known as the "Flyer." All the cars are of steel. The third-rail is the first, says the *Electric Railway Journal*, to be installed to conduct a 2,400-volt current. Along the main line it is of 80 lb. A.S.E.E. section low-carbon rail, and is 32 in. outside the track rails. Approaches to the third-rail at level crossings are provided by bending the rail to form a 4 ft. incline with a total rise of 3 in. The third-rail is guarded on each side by fir boards. There are numerous signs to warn trespassers against the danger of the third-rail. At certain places an overhead wire has been erected, the cars being equipped for both systems. Two sub-stations are in use, and a third is being provided.

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THE
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LONDON, OCTOBER 14, 1915.

Railless Traction Expenses. The recently issued details of the working expenses of trackless trolley cars in connection with the Leeds and Bradford tramway systems are of much interest. The Leeds results are more favourable than those obtained in Bradford, partly because the working expenses per mile run are lower and partly because the receipts are higher in the former than in the latter town. The expenses for the Leeds system for the past financial year amounted to only 4·776d. per car mile, while the revenue was 7d. In Bradford the corresponding figures were 6·557d. and 5·85d., so that there was a small deficit. An examination of the details shows that the costs coming under the heads of traffic and general are much higher per mile run in Bradford than in Leeds, while for repairs and power the Bradford figures are rather lower than those for Leeds. It is not possible from the accounts to get to the actual root of the matter, because those for Bradford are much more detailed that the others. There are no fewer than 22 sub-headings in the Bradford expenses account, while Leeds has only ten. So far as it is possible to tell by inspection, everything included in the Bradford case is not embraced by a process of lumping together in the Leeds items, though this may be done to some extent. It is accordingly probable that if the accounts were stated in the same way in both cases the difference in the totals would not be so great. In any event, even the Bradford expenses figures are encouraging, and there would be a surplus but for the exceedingly low receipts, indicating that the cars run on routes of small traffic. Their value as a feeder to the tramways is not measurable by the accounts, and not only should this value increase, but the revenue per mile run ought steadily to grow. A comparison may be given with two motor omnibus services—Sheffield and Eastbourne. In the former case the working expenses during the past financial year were 7·03d. per mile run, and the receipts were 10·47d. In Eastbourne, where there are no tramways, and where there is a lucrative holiday traffic, the expenses were 11d. and the receipts no less than 14·77d. There does not seem to be any particular reason why the expenses should be 4d. more than in Sheffield, even though the latter is remarkably low. It appears that there are considerable possibilities of economy in Eastbourne. In any case, it is desirable that a greater uniformity should be reached in the method of stating the details of working expenses, both of railless cars and motor omnibuses.

Maintenance of Services. The point that was emphasised in Mr. Dalrymple's paper at the Municipal Tramways Association's Conference on the employment of women conductors, and in the discussion which followed, was the difficulty experienced in finding sufficient men to train as motormen. This trouble is likely to increase the longer the war lasts, owing to the departure of men to assume military service, and also to the refusal of tramway managers to employ those who may be fit for work of more immediate service to the Nation or in connection with the manufacture of munitions. Not one speaker urged that any attempt should be made to bring motormen under the category of war workers, even when they are engaged in driving the cars upon which munition employees depend for transport. It is, indeed, questionable whether any benefit would be derived from such a course, judging by the experience of the general manager of Oldham Corporation Tramways in regard to mechanics in the tramway workshops. The concession of the blue and white forms gives a manager no hold over men

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who see in munition work a means of improving their financial position. As the probability is that while the war continues more and more men will leave the tramway service, it is the more fortunate that in no case have women failed to give satisfaction in the capacity of conductors. Speakers at the conference were apt to insist that local conditions must be the determining factor in their employment in the few towns where women car hands are not to be seen, but after Mr. Fearnley's testimony to the manner in which they work even the hilly routes, only one reason would appear to militate against their employment. Leeds is an example, for there the services of every available woman are required for war work. Of course, the women conductors have yet to demonstrate that they can withstand the added strain of duty in winter; but there is little doubt that with the provision of suitable uniforms and a little extension of welfare work they will be able to do so. For the feminine worker a comfortable room and ever ready facilities for refreshment are a necessity if her health is to be safeguarded. It is already evident that this aspect of their employment as conductors has received careful attention.

A Reserve of Motormen.

One aspect of tramway practice referred to in Mr. Dalrymple's paper on labour problems as affected by the war gave rise to no discussion. The failure to discuss the point is probably not attributable to the matter being a commonplace one on the majority of tramways. We refer to the Glasgow general manager's statement that when the war broke out nearly all the conductors in that city had previously been trained as motormen. The beneficial effect of such a system scarcely needs to be emphasised, either in the case of the municipally or the privately owned undertaking. It enabled Glasgow and other places to keep in service many more cars than could have been retained if there had been no conductors ready to take the places of motormen recalled to the colours or enlisted. The importance of the practice led to a reference being made to it by the Board of Trade inspector in his report on the investigation of the circumstances attending the overturning recently of a Manchester car. For some time since the war, observed the inspector, the tramways department had not been able to obtain sufficient men to enable conductors to be trained as motormen. As the evidence shows, the accident was due to a new motorman, who had not the advantage of knowing the route as a conductor, mistaking his bearings when approaching a curve under the handicap of restricted lighting. Thus the Manchester accident enforces, on the ground of public safety, the advisability of imparting to conductors a two-fold training. But it is the certainty of smooth working under such an upheaval as has been effected by the war that stamps the procedure as a wise one. We have not seen a clearer indication of this aspect than is given in a paragraph contained in the annual report of the Bradford Corporation Tramways. Mr. Spencer, the general manager, expresses his gratification at the hearty co-operation of the employees in bringing the scheme into operation and thus preventing dislocation at the outbreak of the war. This system of organisation was devised as far back, we believe, as 1906, mainly for the purpose of enabling the undertaking to meet emergencies. There is another direction in which this plan can be utilised, greatly to the advantage of the tramways adopting it. That extension of it was made apparent in Mr. W. Mallin's contribution to the discussion on Mr. Dalrymple's paper. The Liverpool manager mentioned that by employing women as cleaners he had been able to send from the sheds to the cars a number of men who were qualified as motormen. A great deal might be said to support a scheme for enabling both conductors and cleaners to secure advancement to the position of motormen after a certain period of service. Apart from its value in an emergency, as shown by the instances already referred to, the scheme is to be commended from the points of view of giving the employees a greater interest in their employment, and of affording the manager a wider scope for the selection of men to occupy the position of inspector. Any step that tends to make car work a vocation with prospects is to be commended. The outlook will not be improved if the Parliamentary Committee of the Trade Union Congress succeed in giving legislative effect, at the behest of the vehicle workers, to the Congress's recent resolve to prevent men under the age of 21 being employed

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as conductors. Such a step will prevent the extension to car operators of the system of apprenticeship which has been introduced into car shops and the permanent way department. Every effort should be made to prevent a restriction of that nature receiving sanction in law, for injury enough has been done to the transport undertakings of London by the police imposing it as a regulation of their own.

Fares and Labour.

Mr. Alfred Baker's paper dealing with financial problems as affecting tramways during the present crisis raised a few points that may seem to be remote, in so far as they will not come to a head until after the war has concluded. One is the probability of the employees claiming the continuance of the war bonuses as wages. These payments, however, were given for the express purpose of helping the men to meet the increased cost of living. In our opinion the payments are to be deprecated. It is a peculiar form of patriotism that expects only a nation's sailors and soldiers to make any sacrifice. Mr. Baker suggested that tramway authorities may find their expenses kept up by certain responsibilities with regard to wounded and disabled soldiers. That work, however, is one entirely for the Government. For months past the Legislature has been trying to devise the best means of bringing into existence the organisation required to administer the very liberal scale of pensions from voluntary funds. Mr. Baker referred disapprovingly to suggestions that he had heard made in some quarters, namely, that reconstruction of track should be postponed, and repairs of rolling stock reduced to a minimum. The safest course to follow will be to carry out only such work as is required to keep the cars in service. As to increasing the fares, a reason additional to the war is involved in the case of Birmingham. When that city took over the remainder of the company tramways, the fares were revised on a too generous scale. The present addition of a halfpenny is not a burden to any worker in these days of a plenitude of work and wages. Birmingham's experience should be taken to heart by the Tramway Committee in any town in which there appears to be any danger of a deficit. All that is required of a municipal tramway is that it should maintain its sinking fund payments, meet the interest on outstanding debt, and make some contribution to the relief of the ratepayers upon whose credit the undertaking was established. In some cases these results have been possible of achievement this year only by reducing the amounts usually set aside for depreciation and repairs. In this respect the Birmingham Committee are not blameless, and Mr. Baker acted wisely in striking a note of warning against the exactions of the finance committee in order to "keep down the rates." In the case of the fortunate towns in which those responsible for tramway policy have so adjusted the fares that the undertakings have endured, comparatively scathless, the economic disturbance incident to the war, it is not suggested that changes should be made. Indeed, it is eminently desirable that municipalities should not raise the prices charged by their trading departments in the present crisis unless such a course be financially inevitable. Every effort should be made by careful management and the restriction of services not essential to the well-being of the community to avoid adding to the burdens of the workers. When all this has been done, and it appears that the ratio of expense to receipts is too high, it would be less than fair to ratepayers to refrain from increasing fares. In this matter no general principle can be laid down except that "the tramway passenger should pay for his ride." His ride may legitimately cost more in one town than another; but whatever it cost, that cost he should pay. The bane of the tramway industry has been that because the more favourably conditioned undertakings have been able to offer very low fares it has been assumed that others, less fortunately placed, ought to attempt to grant equally generous privileges. The whole question largely, but not wholly, depends on local conditions. If the discussion seemed to be inconclusive, and to some extent futile, it was due to a failure to recognise this fact with sufficient clearness.

Ormesby Railless Car Installation.—The North Ormesby and Grangetown Railless Trolley Car Company expect to have their undertaking open by the end of October. The service will give the well-populated district east of Middlesbrough a substitute for the proposed tramways. The North Ormesby terminus is at Smeaton Street; that for Grangetown is at the Market Place, and for Normanby at Redcar Road. A bridge has been constructed over the railway near South Bank, Middlesbrough, and close by the car shed has been erected.

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MUNICIPAL TRAMWAYS ASSOCIATION

Fourteenth Annual Conference, held in London, September 23rd and 24th, 1915.

After a hiatus of one year the Municipal Tramways Association have again held a conference, though on a scale much smaller than that customary in the years before the outbreak of the present war. The last conference—a most successful one, marked among other things by the reading and discussion of papers of first-class importance—was held in Sheffield two years ago. The arrangements for the conference of 1914, which was to take place in Salford, were in progress when the catastrophe of the European war came upon us. Unsettlement of all the ordered affairs of peace and preoccupation over the necessary steps to be taken in the tramway, as well as in all other businesses, made it impracticable to hold that conference in any satisfactory way. Consequently it was entirely abandoned and the Association had to be content merely to mark time at its annual business meeting, which took place in due course.

In the circumstances, it was fitting that Alderman Linsley, of Salford, should be continued in the presidency of the Association for another year, and the hope was that a 1915 conference would be held at Salford on a full and even an augmented scale. The war dragged on, however, and when the past summer arrived and members of the Association were still engaged on business problems arising out of it, the decision was reached that no regular conference should be held this year. At the same time it was felt that there were some points relating to the operation of tramways under conditions created by the war which, in the interests not only of members of the Association, but also of the public, should be discussed. There are various problems in connection with the working of tramways and with their finance which have taken on quite new aspects within the past fourteen months, and an exchange of information and of opinions among tramway authorities all over the country could not be otherwise than beneficial.

As a result of these considerations, it was resolved to hold a short informal conference lasting only one day, the business meeting to follow on the next day. No papers were to be read, but two discussions were arranged on what may be called war topics. It was also arranged that the gathering should take place in London instead of in Salford. The elaborate arrangements usual at conferences for visits to power-stations and engineering works, for excursions, and for the hospitalities that have been so profusely extended to the Association were discarded, and the Association had a simple business-like meeting, very much in earnest and with the proceedings closely confined to the discussion of two subjects.

Owing to circumstances arising out of the war, the attendance was naturally smaller than usual. The fact certainly did not arise because of any decrease in the membership of the Association, because the report of the Executive Council shows that the membership is the same as it was a year ago. But whereas the Sheffield conference was attended by 175 delegates, representing 72 local authorities, on this occasion 100 gentlemen, representing 50 local authorities, attended. Though a good many familiar faces were absent, there was ample opportunity for greetings and interchange of facts and opinions between men who, bound together by kindred interests, have few occasions of meeting each other. The circumstance that the usual social engagements of the conference were omitted on this occasion enabled members to devote more time to personal intercourse, and they have been heard to maintain that they derive more useful information in this way than from hours of formal discussion.

The conference, of which, in accordance with our usual custom, a full report is given in the following pages, opened on the morning of Thursday, September 23, in the Surveyors' Institution, Great George Street, Westminster. The proceedings were begun by Alderman Linsley delivering his presidential address. This was short and practical, and consisted largely of a summary of the work carried out by the Executive Council during the past year. It could at once be seen that however disturbing the circumstances of the time the Executive had carried on useful work in a variety of directions, including both financial and engineering matters. A subject of concern to every tramway administrator at present, namely, the supply of labour, was briefly touched upon, and the President mentioned that about 1,700 women are now engaged in traffic work on municipal tramways. His remarks on this subject came as a useful preliminary to the discussion which followed.

Tramway labour problems, as affected by the war, was the subject of the discussion referred to. It was opened by Mr. Dalrymple, of Glasgow, who described the steps which he had taken to remedy the shortage of employees caused by the large number of men who have joined the forces of the Crown. The men who had left the traffic staff amount to no less than 60 per cent. of the total in that department. Special interest attached to Mr. Dalrymple's statement as to the employment of women as conductors, seeing that over 800 of them are so engaged. The subsequent discussion showed that the satisfactory results which have been obtained in Glasgow have also marked the employment of women as conductors in a number of other towns. It was natural that the representatives of tramway undertakings in the London area should bring forward their complaint that the Commissioner of Metropolitan Police forbade the employment of women as conductors. Though it had not been arranged that any resolutions should be submitted to the conference, the importance attached to this subject was marked by the fact that a motion was put and unanimously adopted requesting the Executive Council to approach the Home Secretary and urge the removal of the restriction. Some hope was given by an announcement by Mr. Goodyer, of Croydon, that he had reason to believe that the Commissioner of Police was likely to abandon the cast-iron attitude regarding licensing matters. In any event, the Executive can put a very good case before the Home Secretary, seeing that so many towns which are not hampered by the metropolitan police are employing female conductors with success.

In the afternoon a spirited discussion took place on "Some Financial Problems as affecting Tramways during war time." This was introduced by Mr. Alfred Baker, general manager of Birmingham Corporation Tramways, who took the view that as a rule municipal

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tramways had given too cheap fares, and had offered other concessions to such an extent that the undertakings could not adequately carry on their work and maintain their installations in a proper state of efficiency. In Birmingham, for instance, the financial problem had become acute owing to the increased expenses due largely to the war; and the Tramway Committee had boldly grappled with the difficulty by reducing the distance for which they carried passengers for one penny. This action had been regarded in certain quarters as an awful mistake, but the result showed that this policy was right. Birmingham citizens recognised that tramway fares, like everything else, must go up. They paid the extra fares and did not grumble. Figures were given with the object of showing that the increases had been wisely imposed and that the result was a real gain to the undertaking. Mr. Baker urged the wisdom of prompt action at the present time in dealing with fares. In his opinion "war bonuses" had come to stay; they would not be willingly surrendered by employees after the war. At that time there would be a "tremendous slump"; traffic, now inflated owing to the high wages, would diminish, the tramway undertakings would find themselves under fresh responsibilities, and at the same time it would be impossible for them to raise fares. The only remedy was to use foresight and to increase fares at once where they were too low, while the public would not feel the change.

The discussion which followed was of special interest, inasmuch as it elicited wholly divergent views, which were obviously largely coloured by the financial position of the undertakings with which the various speakers were connected. Mr. R. A. Smithson, chairman of Leeds Tramway Committee, deprecated the somewhat pessimistic tone which had been given to the discussion. He thought the basis of fares fixed by municipal tramways had, on the whole, been justified by results. The public appreciated the tramway privileges which had been given to them. They responded to the efforts that had been made by the tramways to meet their needs, and in doing so they had made the undertakings "on the whole quite sound and prosperous." He was astonished that the citizens of Birmingham had so willingly accepted the considerable increase in fares; he could not imagine fares being increased in Yorkshire towns to anything like the same extent and being received without a murmur. He was not at all certain that tramway expenses after the war would be as great as they now were. There was no object to be gained in taking too pessimistic views. Bailie Alston, of Glasgow, took a similar view, although laying emphasis on the necessity of managing municipal tramways on a sound financial basis. It was essential to the success of municipal trading that the sinking fund and the depreciation fund should receive all that they could rightly claim before one penny was paid in relief of rates. Mr. J. M. McElroy thought it ought not to go out from the conference that the right way to meet the difficulties through which they were passing was to increase fares. Lower fares might be compatible with increased net results. It was true in every city in the world that there was a growth year by year in the number of riders per head of population, and this tendency should not be repressed. They should approach the question of fares with great care and avoid panic legislation. Mr. J. B. Hamilton, of Leeds, counselled greater efforts to effect economies in working expenses, rather than the raising of fares. Municipal tramways should carry people for the lowest price they possibly could. The discussion was continued by other speakers until the hour of adjournment. Mr. Baker, in a brief reply, pointed out that if fares were too low —and they were so in many cases—the only way to maintain the undertakings on a sound basis was to raise the fares so that there should be a sufficient margin over expenses. His paper was, he said, merely a statement of how they had surmounted the difficulties in Birmingham. Their action promised to be highly successful.

On Friday morning a meeting of the Executive Council was held, and this was followed by a meeting of the managers' section. At 11 a.m. the annual general meeting took place, President Linsley taking the chair. The report of the Executive Committee, which is given in the following pages, showed that the Council had been active in many directions. In reference to war matters, it was stated that some 30 per cent. of the employees of municipal tramways had joined the Forces, thus creating a situation that had seriously affected the efficiency of tramway organisations. If the services were to be maintained it was necessary that a certain number of specially skilled men should be retained, and the Council had laid the facts before the Minister of Munitions, but it appeared as yet somewhat doubtful whether work in connection with tramways could be strictly regarded as being work for war purposes. Defects in tramway controllers, depreciation of motor omnibuses, standardisation of tramway rails, tires, and axles, and rail corrugation were other subjects dealt with in the report; and in respect of some of these matters the Council showed clearly that useful results had been accomplished. The report was approved without comment, an indication, as was afterwards mentioned, of the satisfaction of the members with the way in which the Executive Council carries on the regular work of the Association.

The election of officers was, as usual, effected with gratifying unanimity. Mr. Peter Fisher, general manager of Dundee Corporation Tramways, was unanimously elected president for the ensuing year. Mr. Fisher is one of the three or four original members of the Association; he has attended all of the conferences, and has long been a member of the Executive Council. He has, therefore, an extended experience of the work of the Association, and will undoubtedly make an energetic and capable head. The election of Mr. Henry Mozley, general manager of Burnley Corporation Tramways, as vice-president was also a well-deserved honour to a member who has served the Association well in many directions. Mr. C. J. Spencer was re-elected as hon. secretary and consented to serve for another year, intimating that his fifth year of service in that capacity should bring release from the cares of that office. In acknowledging the compliment, Mr. Spencer expressed his gratitude to the members for their loyal co-operation during the years he had held the position, and he added his appreciation of the services of his assistant, Mr. J. W. Falkingham.

The five vacancies on the Council were then filled by the election of four members due to retire this year and of Alderman W. H. Littler, vice-chairman of West Ham Corporation Tramways Committee. The following members now compose the Council:—

President - Mr. Peter Fisher.
Vice-president—Mr. Henry Mozley.
Hon. Secretary Mr. C. J. Spencer.

Mr Alfred Baker.	Mr. G. W. Holford.
Mr. W. Clough.	Mr. J. M. McElroy.
Mr. A. L. C. Fell.	Alderman H. W. Littler
Alderman G. Flint.	Alderman J. Miles.
Mr T. B Goodyer.	Alderman J. H. Rogers.
Mr. J. B. Hamilton.	Alderman C. J. Spencer.

The meeting closed with a vote of thanks to the retiring president, Alderman Linsley, for his services during the past two years.

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THE MUNICIPAL TRAMWAYS ASSOCIATION.

The 14th Annual Conference of the Municipal Tramways Association was held on Thursday and Friday, September 23 and 24, 1915, at the Surveyors' Institution, Great George Street, Westminster, S.W. The President of the Association (Alderman H. Linsley, J.P., chairman of the Salford Corporation Tramways Committee) occupied the chair, and a representative gathering included the following members and delegates :—

LIST OF DELEGATES.

Aberdare	A. J. Abraham, manager.
Ashton-under-Lyne	Ald. R. S. Oldham, chairman. Ernest Holt, general manager.
Bexley	H. P. Stokes, general manager.
Birkenhead	Coun. H. Halsall, chairman. C. Clarke, general manager.
Birmingham	A. G. Ellaway, vice-chairman. A. Baker, general manager.
Bolton	Ald. John Miles, J.P., chairman. Coun. Z. Smith, member of committee. John Barnard, general manager.
Bradford	Coun. S. C. T. Newman, vice-chairman. C. J. Spencer, general manager. J. W. Falkingham.
Burnley	Henry Mozley, general manager.
Burton-on-Trent	A. B. Slater, manager.
Bury	Ald. T. S. Collinge, chairman. Coun. H. Hargreaves, vice-chairman. William Clough, general manager.
Cardiff	Ald. Sir J. W. Courtis, J.P., chairman. Arthur Ellis, general manager.
Chesterfield	R. L. Acland, general manager.
Colchester	R. C. Bullough, general manager.
Coventry	Coun. C. V. Pugh, J.P., chairman. Coun. H. W. Wale, J.P., vice-chairman. T. R. Whitehead, general manager.
Croydon	Ald. Allen, J.P., chairman. Coun. J. Pelton, vice-chairman. T. B. Goodyer, manager.
Dundee	Coun. Johnston, chairman. P. Fisher, general manager.
East Ham	Ald. M. Oakes, J.P., chairman. W. C. Ullmann, general manager.
Erith	J. Williams, manager.
Exeter	Ald. H. B. Varwell, J.P., chairman. H. C. Bartlett, manager.
Glasgow	Bailie R. Kirkland, chairman. Bailie J. Alston, vice-chairman. J. Dalrymple, general manager.
Halifax	Ald. C. F. Spencer, chairman. Ald. A. Fawcett, vice-chairman.
Huddersfield	R. H. Wilkinson, general manager.
Ilford	Coun. W. J. T. Cullis, chairman. Coun. O. Waters, vice-chairman. L. E. Harvey, manager.
Ilkeston	Geo. H. Browne, acting manager.
Ipswich	F. Ayton, general manager and engineer.
Keighley	Coun. A. Smith, chairman. H. Webber, general manager.
Leeds	Ald. R. A. Smithson, chairman. Ald. H. Brown, vice-chairman. J. B. Hamilton, general manager.
Leicester	Ald. S. Flint, chairman. Ald. George Banton, vice-chairman. A. F. Lucas, manager. T. R. Smith, engineer.
Leyton	Coun. J. A. Hennah. F. Schofield, manager.
Liverpool	Ald. F. Smith, vice-chairman. Coun. J. Clancy. C. W. Mallins, general manager.
London County Council	W. J. Squires, J.P., chairman. Capt. Theo. Prestige, vice-chairman. A. L. C. Fell, chief officer. J. K. Bruce, deputy chief officer. L. Slattery, traffic assistant.
Maidstone	A. T. Lambert, general manager.
Manchester	Ald. J. Bowes, chairman. Coun. A. W. Chapman, vice-chairman. J. M. McElroy, general manager.
Newcastle-upon-Tyne	Coun. R. Mayne, vice-chairman. Ernest Hatton, general manager.
Northampton	John F. Cameron, general manager.
Nottingham	John Aldworth, general manager.
Oldham	J. W. Dugdale, general manager.
Plymouth	C. R. Everson, general manager.
Preston	J. F. Simpson, general manager.
Reading	Ald. C. G. Field, J.P., chairman. G. F. Craven, manager.
Rochdale	Ald. James Taylor, chairman. Geo. Webster, general manager.
Salford	Ald. H. Linsley, J.P., chairman. G. W. Holford, general manager.
Sheffield	Ald. J. Knowles, J.P., chairman of Engineering Sub-committee. A. R. Fearnley, manager.
Southampton	Ald. F. A. Dunsford, J.P., chairman. W. T. Robson, general manager.
South Shields	J. C. Whiteley, general manager.
Stockport	Ald. C. Sharples, chairman. Ald. Wm. E. Hamnett, vice-chairman.
Swindon	T. Medcalf, manager.
Walsall	R. L. Horsfield, manager.
Walthamstow	Coun. Clarke, chairman. Coun. R. J. Bishop, vice-chairman. W. Murray, manager.
West Ham	Coun. H. Dyer, mayor. Ald. H. W. Littler, chairman. J. S. D. Moffet, general manager.
West Hartlepool	C. Burgess, manager.
Wigan	Frank Buckley, manager.

Sydney F. James (hon. solicitor), town clerk, Ilkeston.

The PRESIDENT, in opening the proceedings, said :—Gentlemen, I am very pleased to meet so many tramway representatives here this morning. No doubt the conditions under which we are living at the present moment make the numbers very much smaller than they have been on former occasions; but however that may be, I am delighted to welcome you to the conference..

The PRESIDENT then delivered his address, which was as follows :—

PRESIDENTIAL ADDRESS.

By Alderman H. LINSLEY, J.P.
(*Chairman, Salford Corporation Tramways Committee*).

I have to-day the honour of addressing you for a second time as your president, an honour which, I think, is unique in the annals of our association. When, in September, 1913, you first elected me to the office, I and my colleagues of the Salford Tramways Committee, and the Corporation generally, looked forward with pleasure to the opportunity which we anticipated we should have in the following year of welcoming you to the old borough and of extending our hospitality to you all. Unfortunately the outbreak of war in August last year necessitated that the usual procedure connected with the annual conference should be suspended, and a formal meeting only was held to comply with the Articles of Association. At such meeting you again honoured me by re-electing me to the position of president, and I expressed a heartfelt wish at the time that before another year came round we might have reached the end of the dreadful disturbance which had only just then commenced. Our hopes have, however, not been realised, and to-day we still find ourselves in the throes of this gigantic encounter, and little, indeed, to guide us to the date when a settlement shall have been arrived at.

Under these circumstances we have again had to decide that for the present year our conference arrangements should be modified, and that we should content ourselves with holding a meeting only at which our formal business could be transacted and an opportunity afforded for an informal discussion on tramway matters as affected by war conditions. I do not propose, therefore, to labour you with a lengthy presidential address, but merely to submit a few remarks which may be of interest.

The Executive Council of the association have continued to hold meetings during the year to deal with matters of importance, and you will read in their annual report a summary of the business which has occupied their time and attention. But I think a passing reference to some of the most important items which have been dealt with may be of interest.

From a perusal of the report members will see that the Council of the association have been kept busy during my year of office with sundry matters which affect seriously tramway interests; for example, during the past year it will be noted that the association have been successful in pressing their claims for protective clauses against the efforts of railway companies to run omnibuses and road vehicles over the public highways. The Council have also given close consideration to the vexed question of the allocation of the burden of road maintenance as between road users, and have kept closely in touch through their Parliamentary agents with the Government department considering the matter. In this and other important matters that the Council have set out in more detail in their report—which I hope will be read with care by every member of the association—the interests of municipal tramways have, I think you will agree, been carefully guarded and watched, and the association is to be congratulated upon an active and live Executive Council.

It is recognised that upon many matters of importance it is in the interests of the association to join hands with other similar bodies

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who have like interests, and with that laudable and proper object in view several conferences have taken place with representatives of other associations, such as the Association of Municipal Corporations, the Tramways and Light Railways Association, the Institute of Municipal Treasurers and Accountants, and the Incorporated Municipal Electrical Association, etc. This gradual welding together of large associations aiming at a common object cannot but mean good for all concerned, and is in the interests of municipalities as a whole.

The Council have seen that the technical and engineering side of tramway activities should not be neglected, and are taking a keen interest in the development of various types of vehicles which have come into use since the inception of the orthodox tramcar with its wheels and rails, such as the petrol motor omnibus and the trackless trolley car, and even later still the battery vehicle. A representative has been appointed on a committee of the Incorporated Municipal Electrical Association, comprising representatives of vehicle manufacturers, electric supply companies, and other kindred bodies, which has been formed to encourage the development of electric vehicles.

Technical questions affecting public safety have had consideration, and joint conferences have taken place with representatives of the Tramways and Light Railways Association on the question of defects in tramcar controllers which it appears, according to the Board of Trade, have in the past contributed towards accidents. It is to be hoped that the efforts of our technical men will be rewarded with a measure of success, though the fact must never be forgotten that whilst the municipal tramways of this country are carrying enormous masses of people every day the percentage of accidents is extremely low, and it would not be difficult to prove that tramway travelling is about the safest of all methods of mechanical traction at present in vogue.

The Association have not been idle in connection with financial questions as affecting municipal tramways, and they are now busily engaged in negotiations with other associations of like interests, with a view to obtaining a standard and equitable system of assessment for income purposes in respect of motor omnibuses. They have, in addition, been in negotiation with the Institute of Municipal Treasurers and Accountants with respect to the proper allocation of interest on tramway funds' bank balances and other matters. It is pleasing to note that the representatives of the institute have agreed with the principle that tramway funds should be fully credited with all the interest which is obviously their due. At these various conferences with the representatives of other associations the utmost good feeling has prevailed, and much benefit has been derived from the interchange of views.

Alderman H. Linsley.

Such a world-wide disturbance as is now happening could not fail to have had varying effects on the business undertakings in which we all here are more particularly interested, i.e., municipal tramways. I think it will be admitted that we do form a very important branch of the business life of this country when we find that £56,000,000 of capital are sunk in municipal tramway enterprise alone, and over 55,000 employees are directly connected with our undertakings. It is very gratifying to know that as a result of the appeal to the men of this country to come forward and help to meet the impending danger over 16,000 (or 30 per cent.) of the municipal tramway employees have gallantly responded.

Many of these men have nobly laid down their lives in their country's cause, and many more have sustained pain and suffering from wounds and other causes, but their comrades and their employers will, I am sure, see that their names and deeds are not forgotten, and that in time to come we shall all look back with satisfaction and pride at the loyalty displayed by the tramwaymen of the country in this great and historic war. In addition to the large number of men who have entered the field for active service, many more have left their everyday life in the tramway workshops to assist in the important task of munition work.

The raising of such a large army as we are now proud to know exists has naturally taken from the industrial and other areas numbers of people who comprised daily passengers on the tramcars, and consequently it is not surprising to find that heavy reductions in incomes have been sustained by many tramway undertakings. In addition to these reductions of income most of us have had to face also heavy increases in expenditure brought about by the general system of paying either full or part wages to tramwaymen who have enlisted, and I may say that this item to the present date reaches the figure of £380,000 in municipal tramways alone. There has been also the further payment of war bonus, or other extra consideration to meet in addition to the increased cost of materials.

These matters will no doubt be dealt with at greater length in the discussions to-day, as will also the new phase which has entered into the tramway world of utilising female labour upon the cars—brought about by the heavy drain of men of military age and the difficulty experienced in obtaining suitable male labour to replace them.

It is interesting to know that there are throughout the country upwards of 1,700 women at the present time engaged in traffic work alone in connection with our municipal tramways, and possibly this number will be increased very materially in the near future.

There is one other matter which I am pleased to refer to, and that is the valuable help which the many undertakings have been able to give to numerous charitable funds connected with the war by the fixing of collecting boxes on the tramcars. I understand, from figures which our honorary secretary has recently been at the trouble to obtain, that upwards of £23,500 have been subscribed in this way by tramcar passengers, for which I am sure we are all very grateful.

In conclusion, allow me to record my appreciation of the honour bestowed on me in allowing me to fill the high office of your president during the past two years, and to thank you for the many kindnesses and hearty co-operation which has tended to lighten the duties connected with this important office.

Gentlemen, there was another paragraph in this address when I sent it to the printers, but someone has obliterated it. I cannot conclude my remarks to you without mentioning the contents of that paragraph, i.e., a testimony to the very valuable assistance I have received from our hon. secretary, Mr. Spencer, and from our clerk, Mr. Falkingham. Without that assistance I should often have been in a difficult position, and I wish to return them my very hearty thanks. (Applause.)

Alderman J. KNOWLES, J.P. (chairman, Engineering Sub-committee, Sheffield Tramways Committee).—I have been asked to undertake what is a very pleasant duty to me, and I believe that it will be equally pleasant to every one present, and that is to move that the best thanks of the conference be given to our President, Alderman Linsley, for the address which he has delivered to us in such a kind and gentle manner, and also for his past two years' valuable work on behalf of the Association. We always find in him the same gentleness and consideration. I have met him many times when he has come on what I call a " fishing expedition " to Sheffield—when he has come to see if he could catch any fish out of our pond—and I have always been willing to do all I could to help him. In fact, it was impossible to refuse him, for he always came to us so kindly and so affectionately, that anything we can do for him we are quite prepared to do. So it is with the greatest possible confidence that I ask you to accord a hearty vote of thanks to our President, whose term of office has been prolonged, I take it, owing to the exigencies in which we are placed at the present moment, but although prolonged, it has been held no less efficiently by the gentleman whose services I ask you to recognise this morning. (Applause.)

Alderman BROWN (vice-chairman, Leeds Corporation Tramways Committee).—I have been asked to second this motion, which has been so ably moved by my friend on the right, and I may say, in doing so, that I had formed a very high opinion of the President. But I must admit that that opinion has been somewhat altered by the speech from Alderman Knowles to which we have just listened. I have always looked upon our President as a gentleman of taste, but when I hear that he goes to Sheffield to fish, it is quite evident that he has not that taste for which I give him credit. I am quite prepared to admit that there are a number of fishermen at Sheffield,

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but whenever I have seen them it has always been at the railway station, trying to get away from that city. (Laughter.) But when our President goes to Sheffield, I suppose he goes there to fish for something better than the ordinary fish to which my friend Alderman Knowles referred. I have no doubt he has gone fishing in the way of getting information which would be of value to him in his own city of Salford. It is true that Alderman Linsley has held this position for two years, in perhaps the most troublous times that any President will ever be called upon to occupy that position, but Alderman Linsley has occupied it with grace, he has occupied it with dignity, and that he has occupied it also with efficiency I am confident. When I ask you to agree with this resolution, I am sure that you will do it whole-heartedly, because of the onerous times through which he has guided the affairs of the Association. It is equally true that during the past two years the tramway managers of this country, and the other officials who have to administer the tramway undertakings in this country, have had a very onerous time, a very onerous task. I know that in the city to which I and my colleagues belong we have had most anxious times, as is indeed common to all other municipalities, because at the beginning of the war our receipts went down by leaps and bounds. I notice from the figures which have been published in the tramway returns of this country that our experience then was the experience of most of the other towns and cities in the United Kingdom. The vicissitudes through which we have passed have made it all the more difficult to know what to do to carry on the various tramway undertakings as efficiently as the times demanded. Because while the labour difficulties and also the cost of management were increasing week

Mr. Jas. Dalrymple.

by week, the demands of the workers have been all the heavier, because of the nature of the work on which they have been engaged. I am only hopeful, sir, that this may be the last meeting that we shall hold during the crisis through which we are passing, and that in the years to come the Presidents of this Association may have an easier and less anxious time than our President has had during his term of office. I join with the mover of the resolution in asking you to accord to our President a very hearty vote of thanks for the very excellent manner in which he has presided over the business of the Association during the past two years. (Applause.)

The motion was put by the Vice-president (Mr. Peter Fisher) and it was agreed to with acclamation.

The PRESIDENT.—I am exceedingly obliged to the mover and seconder of this vote of thanks for the kind words they have said in regard to myself. Perhaps some of them I have deserved, and perhaps there are some to which I do not think I am entitled. However, I thank you all, gentlemen, for the very hearty way in which you have received this resolution. In giving up this position, my only regret is that I have not had the satisfaction of entertaining you all at Salford in the way that you have been entertained at conferences in former years; but I hope the time may come when we shall be able to do it. I thank you very much for your vote of thanks. (Applause.)

The President then called on Mr. Dalrymple to open the discussion on Tramway Labour Problems as Affected by the War.

TRAMWAY LABOUR PROBLEMS AS AFFECTED BY THE WAR.

BY JAMES DALRYMPLE.
(General Manager, Glasgow Corporation Tramways.)

The experience of one tramway system during the past year will undoubtedly have been very different from that of another. Each community has, of course, its own peculiarities, and the experience of tramway systems like those of, say, Manchester, Liverpool, Leeds, Sheffield, etc., may not in many respects resemble the experience of the smaller systems. Even the experience of the larger tramway systems will undoubtedly be very different. I should fancy that there are conditions governing the position in Manchester which will not at all apply to the case of Liverpool.

I propose to deal with the question under two distinct headings :—

(1) The general staff, including workshop, permanent way, car cleaning, etc.

(2) The traffic or uniformed staff,

after which I propose to make a few observations on our experience at Glasgow with women conductors.

So far as the general staff of tradesmen and labourers is concerned, the war has not, to any appreciable extent, affected the working of the department. A considerable proportion of the car works and permanent way staffs was, at the outbreak of war, over the fighting age, and we have either secured the services of a few new men over forty years of age to take the places of those who have joined the colours, or we have, in some sections of the work, struggled on with a depleted staff.

In the car works, for instance, the total staff in August, 1914, numbered 512. Of that number, 129 have joined the colours, and at the present time the number of men who are eligible for the Army must be very small. The total staff now numbers 393. This means that we have 119 fewer men in the works than we had fourteen months ago, although we are doing a considerable amount of war work for the Government and for Government contractors.

This, of course, means that our usual overhaul work is not being carried out so thoroughly as it formerly was. We have stopped all new work. It is impossible now to get tradesmen to replace men who are leaving the service. So far, therefore, as the workshops are concerned, the problem is a very simple one. Men cannot be got. In regard to wages, I may say that the great bulk of the men in the works have either received the increase agreed on between the masters and the men in each particular trade, or have been paid a war bonus of 2s. per week by the Corporation.

So far as the permanent way and buildings repair staffs are concerned, I find that in August, 1914, we had a total of 911. Of this number 147 joined the colours. Our total staff at present numbers 776, or 135 fewer than we had fourteen months ago. Of course, all work on extensions has been stopped, and the number of men actually engaged on repair and renewal work is slightly less than before the war.

The car cleaning staff has also been reduced. A good many of our cleaners left the service to join the colours; others left the service with the consent of the department to engage in munition work, and although we would not have much difficulty in filling the places of car cleaners, we have preferred to work with a reduced staff. This means, of course, that the cars are not so carefully cleaned as they used to be; indeed, I am afraid that our cleaners have been engaged so much at bill-sticking work during the past year that car cleaning has been somewhat neglected. In August, 1914, we had 635 cleaners. At the present time we have only 472.

We now come to deal with the traffic staff, and it has been in connection with this section where we have experienced the most difficulty. When war broke out, we had a uniformed staff numbering 3,249. Of that number 1,902 subsequently joined the colours. Our present staff numbers 3,123, so that we are 126 short of the number in August, 1914. In our traffic staff of 3,123 there are included 818 women conductors. Generally speaking, all men who in peace are engaged as motormen and conductors are men who, on account of their age and physical fitness, are suitable for the firing line. Consequently, I should imagine that a larger proportion of the traffic staff will be found to have joined the colours than of any other section of tramway work.

During the autumn and winter of 1914 we made great efforts to keep up our staff of conductors by engaging men who were unlikely to be accepted as fit for the Army; but, with all our efforts, we were unable to keep pace with the leakage which was week by week taking place.

Fortunately, nearly all our conductors in August, 1914, had been trained as motormen, and we were thus able at once to man the front platforms of the cars, and as more motormen left the service we were able to still draw on the remaining conductors. At that time, however, and indeed throughout the greater part of the past twelve months, our men had had to work seven days per week, and even with this help the service during last winter had to be considerably curtailed.

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Before the New Year of 1915 we had arrangements made for trying how women could take the place of men on the rear platform. After these arrangements were quietly made, however, more men seemed to come forward, and we were enabled to go on for a month or two longer, but as recruiting became brisker, more eligible men went off, and by the month of March we were at the end of our tether, and were compelled to try women as conductors.

Since that date we have got very few men, and those who have applied for places as conductors are not of the most suitable type. We are still taking on as many men as we can get, but, notwithstanding that, we have now over 800 women conductors, and are still engaging more.

I might say here that the most difficult problem we have now to face is the shortage of motormen. We are training men as fast as possible, but we are doing no more than holding our own. In order to give the service required, almost every motorman is working seven days per week.

Our starting wage for conductors is 27s. per week, with a war bonus to householders of 2s. per week. The women are paid also at the rate of 27s. per week, but they do not get any bonus. The working week for the whole staff is 51 hours.

In regard to our experience of women as conductors, I should like to say that this has been altogether satisfactory. We started to engage women in March last, and for a considerable time we took on at the rate of 50 per week. From first to last, thousands of applications have been considered. We have always endeavoured to get women from 24 or 25 years of age up to 35, who appeared to be strong physically, and who knew what it was to do a day's work. A large proportion of our women conductors are married. In the bulk of cases the husbands are with the Army. Out of 818 there are about 300 married women and 55 widows.

The regular course of training extends over eight days. The first day is spent in a room at one of the depots. Forms are arranged so that the classes are seated like passengers in a car. There are frequently two classes going on at the same time, each under the charge of a ticket inspector. For the first hour the women are instructed in punching tickets until they become familiar with the handling of the punch. After the whole class knows how to operate the punch, each woman in turn acts as conductor, and goes through the motions of collecting fares, giving change, issuing tickets, calling out stations, etc., exactly as if she were on actual duty. This procedure is continued until all the members of the class have had a turn. The whole exercise is repeated until every woman appears to the inspector to be proficient. The following seven days are spent on service cars under an experienced male conductor.

We have found the women very quick in picking up their duties. You can understand that, as a general rule, the fingers of a woman are more nimble than those of the average man who applies for the position of a conductor. On account of this natural adaptability, passengers, generally, are highly pleased at the way the women conductors get through their work on the cars. We have all along encouraged passengers going to the top deck to pay their fares to the women conductors on the platform; that is to say, when individual passengers are boarding the cars between stations. I have no doubt we may miss some excess fares through this practice, but we hope to get over this difficulty in time.

From the very start our men took very kindly to the introduction of women, and they have all along done their very best to make the work as comfortable and congenial as possible. Of course, our women get the same pay as the men. They have the same working hours, duties, and reliefs. No difference whatever is made between conditions under which each sex is working except that we have never asked a woman to learn to drive, and we very rarely ask a woman to work seven days in one week.

Our women conductors are now working on all routes. Some routes, of course, are very much quieter and more respectable than others; but we find, even on the toughest routes, that the influence of the women conductors is all for good. They appear to be able to handle an unruly passenger quite as firmly and, perhaps, in many cases, more successfully than a man. The uniform consists of a green straw hat with green band, and a tunic made of the same green cloth as the men's garments. They have a skirt made of Black Watch tartan, which is one of the quietest tartans, and as green predominates in this tartan the skirt matches the tunic and hat. We are considering the advisability of providing the women with gaiters for winter wear. A separate waiting-room is provided at all the depots, and at almost every terminus we have a private lavatory for the use of our own staff. As I have said, we have in Glasgow over 800 women conductors at work, each woman doing the full work previously done by a man, and last week we carried more passengers and drew more revenue than during any previous week throughout our whole history.

THE DISCUSSION.

The PRESIDENT.—I think Mr. Dalrymple has thrown out very many good hints that will lead to a useful discussion, which we shall all be pleased to hear.

Mr. C. W. MALLINS (general manager, Liverpool Corporation Tramways).—I do not think that there can be much need for discussion on Mr. Dalrymple's paper so far as female labour is concerned, as I believe we are all agreed that female labour can be adapted for the work of conductors in a great many instances. That is, I think, conceded all round, and also for car cleaning, but it is pretty well understood that wherever there are steep or treacherous gradients to be negotiated it is another problem altogether. I for one would not like to have to go before a coroner's jury or a Board of Trade inquiry to explain how an accident was brought about on one of my steep gradients when there was a lady either at the back or the front of the car. I am of opinion that that is one of the drawbacks to female labour in many towns. I do not know what the views of other gentlemen are upon the point, but that is my view. Female labour can be utilised in car cleaning with advantage. We have done that in Liverpool, and have done it very satisfactorily. But there is another problem in connection with this female labour question. We all most sincerely hope that this dreadful war will be brought to a quick conclusion; therefore if we now fill up our car platforms with female conductors, when that time comes a very serious difficulty will arise, because there can be no question that the brave men who have gone to fight our battles cannot be left out in the cold whilst we keep women on the cars. They must, unfortunately, be turned adrift, and it is difficult to see where they can go if we have them in large numbers, because many of them are drawn from domestic service and other occupations of that sort, which would be closed to them after a certain time, with the result that they will be thrown out of employment. I think that is an aspect of the matter that we should all keep before us. As regards my own city, I am very pleased to say that, by arrangement with the recruiting authorities, we were able to get all the male labour we required for car conductors from a class of men who were ineligible for the army, but we have employed some females in our sheds to liberate the men who were qualified for drivers. By that means we have been able to staff with men the whole of our outside system. That is, I am sure, a great advantage, and is one of the things that I hope the members of this association will seriously take into consideration. It is one of those things that require careful consideration; but local conditions must, of course, be the determining factor in the employment of females. Now whilst I am upon my feet may I refer to another matter. I do not know whether I am in order in making the suggestion—but there is a problem before the country at this moment which, in my opinion, is of far greater importance to the nation than the question of female labour. It is the question of how to utilise the technical skill of this organisation—may I say the intellect and genius of this organisation?—for the purpose of the production of munitions of war. That, sir, is a very important thing—it is the most important thing we know of at the present moment—more important, perhaps, even than men fighting in the trenches, because if the men in the trenches have not the munitions of war which they require it will be bad for the country. I am not at liberty to tell you just what we are doing at Liverpool in that connection, but if you, Mr. President, can see your way to use this organisation in some form or other, with the Council at your back, I have not the least doubt in my mind that the Ministry of Munitions would appreciate anything that you can do. If I am in order I should suggest that you approach the Minister of Munitions in your capacity as President, with a view of utilising all the talent you have got, together with the tools and plant of the association. I believe that good would result, and that your organisation would occupy the place which its importance deserves in the history of the nation when this great war comes to an end.

The PRESIDENT.—In reply to the last suggestion made by Mr. Mallins, I should like to say that to my own knowledge there is a great deal of work being done on munitions of war by the various tramway authorities who have the conveniences and the machines to do this work. Their efforts, I believe, have been acknowledged by the War Office authorities as to what has been done already. Mr. Spencer reminds me that we have offered our services—we have offered to do anything we possibly can.

Mr. MALLINS.—Collectively or individually? The various undertakings I am sure could do a great deal.

The HON. SECRETARY. We have placed the Association at the disposal of the Minister of Munitions.

Alderman F. A. DUNSFORD, J.P. (chairman of the Southampton Corporation Tramways Committee).—Our friend from Liverpool seems to be in an exceedingly happy position. (Hear, hear.) His observations about the women conductors seem to be peculiar, and different from the views of all the rest of us who have had to employ them. No one for a moment has suggested we should put women on to the front of a car. No one would suggest such a thing. (Mr. Mallins.—Why?) Because I do not think they have the physical strength or the nerve power; at any rate, that, I believe, is the generally accepted opinion. In Southampton we tried our utmost to avoid woman labour; we tried boys—they were a great failure. We have now tried women, and have put 20 on during the last few weeks. The result has been successful, and all that we could desire. The women have been smart on the cars, they have adapted themselves to the work, they change the trolley pole as carefully as any of the men have done, and I feel perfectly certain that the result of employing female labour on any tramway system is going to be very favourable. A reference has been made to the

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uniform—a very important thing—and it has been suggested that they should wear gaiters. I take it that the uniform Mr. Dalrymple has in view is the one we shall have to adopt. One that will enable them to endure the weather in the winter will be very necessary in Southampton. Another question is that of the sanitary arrangements. We have a place especially arranged near our depot, which we have handed over to the women, and at the various parts of the lines we have made special accommodation for them, so that we have got over that difficulty remarkably well. I believe that the other difficulty to which Mr. Mallins referred will right itself, because all these women are only put on temporarily. There is no doubt that occupation will be found for them, because we shall be very short of men, and numbers of tramway women may go into other employments. We feel in Southampton that we shall have no difficulty in that way. But there is one thing in which there may be a difficulty. We have given an undertaking to every man who has volunteered and gone to the front that his place shall be reserved for him after the war, and his half pay is to be paid. We have gone further than that. We have guaranteed occupation or employment, through the Education Department, as caretakers, for any unfortunate married women who may become widowed as a result of this war through the loss of their husbands previously in our employ. I need not explain all that this may involve. I rose really to enable you to appreciate the fact that in Southampton and Portsmouth and other South Coast towns the employment of women conductors has met with a very great success.

Mr. W. MURRAY (manager, Walthamstow Urban Council Tramways).—I rise with some diffidence to intervene so early in the debate, because I represent one of the smallest of the London tramway systems; but I deliberately venture to intervene because I feel this question of female labour is second to none in present day importance. I do not agree with Mr. Mallins, at least so far as London is concerned. As regards Walthamstow, it is of more importance than any other question that we have to face to-day. With respect to Mr. Mallin's logic, if women can take the places of men in traffic work, the men are set free to do the work of munition making, so the argument does not hold good. The more women who are employed in connection with the tramway undertakings, the more men will there be set free for other work needed by the nation. With regard to the servant problem, I do not know how matters stand elsewhere, but in Walthamstow domestic servants are as scarce as tramway men, and if women are employed and have after the war to make way for the men again, there are many householders who will be glad to have their assistance in the homes. But my chief object in rising is if possible to secure the assistance of this Association for those tramway systems in and around London who at present are unable to employ women. Our position in Walthamstow is this. We are largely a pleasure-riding tramway undertaking, especially in the summer time. Throughout the whole of the summer we have never been able to cope with the traffic at rush times. The result has been constant and persistent complaints about missed fares. The overloading has sometimes been a public danger; it has been so bad that even the police themselves have not been able to control it. We have at the outside termini crowds of passengers, and sometimes the cars, which were built to accommodate 52, get loaded up with 80, 90 or 100 passengers, with the consequence that the rolling stock has been strained and the public put to very great danger. Early in the summer I foresaw that women must be the only solution for the scarcity of tramway men, especially as conductors. I approached the police authorities and asked to be allowed to employ women conductors. I asked the police to license them. The reply I received from the police authorities was that they had no reason to believe that there was an insufficient supply of suitable labour. I agitated the matter in the Council, and got the Council itself to write again to the Commissioner of Police, and as a result he flatly refused to consider the matter at all; he said it had already been considered and decided upon and that he would not reopen the question. Since then the Council have approached the Home Secretary, and we have received a reply that the matter is under consideration. I saw it stated in one of the technical papers last week that the Scotland Yard authorities are saying they cannot license women as conductors because it would upset the trade unions. (Laughter.) I would like to know since when the police authorities have bound themselves to protect the trade unions. (Laughter.) We in London, who are situated in a very different position from the provincial tramway undertakings, have some claim upon the help of this Association. Here is a position in which the public are in danger; the tramway undertaking has not been able to cope with the summer service; workmen cannot get to their business in the morning because men who have been working long hours seven days a week, for six, seven, or eight months past, sleep on in the morning and do not turn up at the depots to time. Sometimes we have 12 or 14 men who fail to report themselves in time enough to get out the early workmen's cars. The position is grave, and yet the police authorities take up the attitude that they will not move and will not help. I think this is a matter in which the Association might aid us, and I hope that the discussion will bear some fruit. The London members should make their voices heard, and if need be force the Executive to take some action in supporting the London tramway managers in trying to get power to do what is done in every other part of the kingdom, and done with marked success, i.e., employ women as conductors. (Applause.)

Alderman Sir J. W. COURTIS, J.P. (chairman, Cardiff Corporation Tramways Committee).—I should like to express my indebtedness to Mr. Dalrymple for his useful paper on tramway labour problems. I think that the licensing difficulty referred to by the Walthamstow representative might be got over if all authorities did the same as we do at Cardiff; that is, we license our own men. (Hear, hear.) Some years ago licensing matters at Cardiff were in the hands of what was called then the Cabs Committee, but difficulties having arisen we thought that the best way of dealing with the question was to take over these duties, feeling that we were the best judges as to who should be licensed, and the Corporation agreed to this change being made. (Hear, hear.) Mr. Dalrymple has given us very interesting information in regard to the employment of female labour on the tramways. We have already dealt with this question at Cardiff, and are at the present time employing between 50 and 60 women. Our experience has been similar to that of Glasgow. Mr. Dalrymple has answered a question I intended putting to him relative to the age of the women employed as conductors. I think we shall probably have to make a little alteration in that respect, because we are employing younger girls than is the case in Glasgow. I do not think it is advisable to take them on for tramway duties too young. Boys we do not find altogether satisfactory as conductors. The work is picked up by the women, I must say, very quickly. Mr. Dalrymple stated that no objection was raised by the Glasgow men to the employment of women conductors, and in fact, that they encouraged the employment of female labour in every way. We did not have a similar experience in Cardiff. We should not have been able to carry on a satisfactory service without the assistance of the women, and therefore decided that they must be employed. How far the employment of female labour will be increased remains to be seen. We find women do the work well, and our receipts are keeping up well; in fact, they are surprisingly good, having regard to all the circumstances; and therefore we can endorse Mr. Dalrymple's view that the employment of female labour has been a success.

A DELEGATE.—What is the pay?

Sir J. W. COURTIS.—We pay 5d. an hour, but we are employing girls. At the start they did not take on full duties, but they are doing so now, as is done at Glasgow. With regard to the question of uniform, to which Mr. Dalrymple shortly referred, we have double deck cars, and there is the question of the staircases. We adopt the same method as has been tried at Glasgow, and collect as many fares on the conductor's platform as possible, but it is not always possible to collect them all in this way, consequently there is a good deal of running up and down the staircases. How that will affect the women remains to be seen. The question of uniform for winter is rather a difficult one to solve. Our female conductors at present wear a blue serge skirt and tunic, but I do not know how this dress is going to answer in the cold weather. I do not agree with my friend Mr. Mallins in the view he takes regarding the employment of females. I think after he has had a little more experience of this class of labour he will change his opinion. I think that national service is coming. When it does we must be prepared to lose more men. The age limit will probably have to be extended before the finish of the war. A gentleman expressed the hope just now that the war would come to an end quickly. I devoutly hope so too, but I think that is taking too sanguine a view of the situation, and if we are prudent we shall provide for prolonged hostilities. I am sure everyone present will appreciate, as I do, the very valuable paper given by Mr. Dalrymple, which has produced a very useful discussion, from which we should all profit.

Captain THEO. PRESTIGE (vice-chairman, London County Council Highways Committee).—If I may I should like to make a suggestion arising out of the discussion as regards London especially. The position of London appears to be that the tramway managers are making up their minds as to whether or not it would be possible to utilise women conductors, and I think on the whole the result of this meeting will be that the London managers are of opinion that women can be used to some extent. The difficulty lies with the police, who are not willing to give the necessary authority for this to be done. I should like to suggest to the association that some definite action should now be taken in regard to the matter. There is no doubt that a very useful way of approaching the matter would be for this meeting to pass a resolution in regard to the employment of women in London, and endeavour to get the assistance of the recruiting officer for London to press the claims of employment of women on the Government. At the present time the chief recruiting officer for London is listened to by all the Government departments, and I feel sure that he would be very glad to use his best endeavours in this direction if an influential meeting of this kind were to pass a resolution calling upon him to do such work.

Mr. T. B. GOODYER (general manager, Croydon Corporation Tramways).—May I say for the information of the metropolitan managers that some months ago I had communication with the Commissioner of Metropolitan Police in regard to the employment of women on the Croydon tramway system. The police absolutely declined to entertain the proposition. The correspondence was considered by the Executive Council, who were quite prepared to

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assist in the direction indicated. I understand now from Mr. Fell, quite unofficially, that at the present moment the Commissioner of Police is likely to veer round from the cast-iron attitude he generally adopts with regard to transit and licensing matters in the metropolitan area.

Alderman H. BROWN (vice-chairman, Leeds Corporation Tramways Committee).—I should like to say a word in regard to the subject which has been so well introduced by Mr. Dalrymple. So far as Leeds is concerned, up to the present we have not engaged women labour for our cars, although I know that it was in the mind of our manager some considerable time before Glasgow or any other Corporation employed them. But in Leeds we are differently situated from most other towns. There is always a big demand for women's labour in Leeds under ordinary conditions, and since the war broke out the demand for women's labour in our city has been as great as the demand for male labour. Thus up to the present we have not engaged any women conductors. But so far as I am concerned, and I think the other members of my committee too, we are all ready at any moment when it is necessary to put women on our tramcars. There are one or two lessons we might learn, and I hope we shall bear these matters in mind in times to come. I was particularly struck by the figures given by Mr. Dalrymple as to the number of the staff at present employed as compared with the number employed before the war. And then we have the statement that during the last week, even with this depleted staff, the Glasgow tramways carried more passengers and took more money than has ever before been done in the history of the undertaking. We congratulate Mr. Dalrymple and his committee upon achieving such a splendid result. In the times to come there is not the slightest doubt that the tramway undertakings of this country will be called upon to contribute more largely than they have ever done before to the relief of the rates of their various municipalities. The lesson to be learned from the results which Mr. Dalrymple and others have explained to us is how far can the working expenses of our undertakings be reduced and the systems still be worked efficiently. There have always been suggestions—I am not going to say that they are all true -but there have always been suggestions that municipalities employ more labour than is actually necessary. I know the temptation that there is to do it, because those who have been members of Town Councils for any number of years, or any manager of a department of a city Corporation, will be prepared to admit that pressure is always being brought to bear upon them by outsiders to employ more and more labour. The point therefore is how far in the future we can reduce labour. Reduction has been effected at the present time, though I do not say that the systems have been carried on as efficiently as in the past. But I do hope that we shall all learn some lessons as to how far we can reduce labour upon our undertakings and still work the tramway systems with efficiency in the years to come. I have heard a great deal of criticism about the employment of female labour. We have had some of it brought forward by one or two speakers. I think the women of this country owe Mr. Dalrymple a debt of gratitude for the way in which he has spoken up for them, and I venture to say that his speech will be quoted many times in the days to come when we are discussing the employment of women in various works which up to this war had never been thought of. I quite understand Mr. Dalrymple saying, so far as Glasgow is concerned, that they have had no difficulty with rowdyism on the cars. The way in which the women conductors have been treated has been everything that he could desire. But then we quite expect that from Scotchmen. (Laughter.) We in Leeds have had experience of a Scotchman. (Laughter.) I have heard him criticised a thousand times by men, but the ladies have always spoken most affectionately of him. It is quite evident that Scotchmen, so far as Glasgow is concerned, are sufficiently gallant to women conductors, so as to cause no inconvenience or misgivings on the part of the Tramways Committee. I believe that women have come to stay in the labour world for many, many years to come—perhaps for all time. We not only have the testimony of the manager of one of the greatest tramways in the United Kingdom, but we also have the evidence of other managers. I venture to say that Sheffield, Newcastle, and other places will all speak in equal terms with regard to the way in which the women have done their work. I was talking the other day to the manager of one of the greatest businesses in the United Kingdom which has had to allow its clerks to answer the call of the nation, and where they have brought in young ladies to take the place of the clerks who have gone. He told me that the work has never been better done than it is being done at the present time, that the women were more accurate with their figures, that they were as good time-keepers, that they were clean in their habits, and that the whole scheme of employment of female labour had proved a huge success. We find this in banks, in insurance offices, in tramway undertakings, and in a score of other ways, where women have had to be brought in to do men's work. The only point that I am afraid will lead to trouble is this. I do not like the idea—although I know that it is very difficult to defend on a public platform—of bringing in ladies who have had no experience, who have never spent any time in learning a trade, and immediately begin to pay them at the men's rate of pay, because you will find if you are going to pay women conductors twenty-seven shillings a week to begin with you are going to put yourself in competition with every other tradesman and every other employer of labour in the city to which you belong. That is a vital question, because there are very few trades that can afford to pay the cheapest female labour twenty-seven shillings a week, and that is a difficulty which we shall have to find how to get over. I do not know how you will get over it, but I am one of those who are delighted to find that whilst men are called to serve the colours, women have entered the difficult positions to which they have been called, that they have discharged their duties with so much ability, and have done their best to help us over these difficult times. I trust that, whatever the wages question may be in the future, we shall find that the women can do more work than ever they have been given the credit for. I am delighted that our systems are being so well conducted with the assistance of women. There is one question I should like to ask of Mr. Dalrymple. I understand that these women conductors train for eight days in classes and then seven days on the cars?

Mr. DALRYMPLE.—One day in class, eight in all.

Mr. BROWN.—Do you pay them the 27 shillings right from the time they begin learning?

Mr. DALRYMPLE.—If the conductor goes through her course of training and goes on as a conductor she is paid for the first day she comes in to the class. But if it is found in the course of their training that candidates are not able to go on with the work, they leave and are not paid anything.

Mr. A. L. C. FELL (chief officer, London County Council Tramways).—I only want to say one word with regard to the police in the London area. It is only right to state that the Commissioner of the Metropolitan Police has tried to meet us in every possible way to maintain our tramway service. He has allowed us during the last 12 months to overload the cars to practically an unlimited extent. We have by that overloading been able to release a large number of men, and thus avoid crippling the whole service. The Commissioner in allowing us to overload our cars has given us, I think, an excellent argument against the employment of women. I candidly think that on these overloaded cars it would be scandalous to ask any woman to go and collect fares at the rush periods of the day. Notwithstanding that, there are many systems and parts of our own system where women might be most usefully employed, and I have every hope that the Commissioner of Police will allow us to employ them on those parts of the system. For instance, we have recently introduced trailer cars, and there is no earthly reason why women should not act as conductors on those cars. We have single deck cars running through the subway under Kingsway, and there is no reason why women should not work on those cars. I think there are also many cases in outlying areas where women might be employed.

Alderman F. SMITH (vice-chairman, Liverpool Corporation Tramways Committee).—If a stranger had walked in here and had heard this discussion he would imagine that we were talking about some strange species of which we had never had any previous experience in all our lives (laughter), and yet we are considering what people would call a problem of dealing with the labour of women. It is as clear as noonday that a woman is an individual entitled to earn her own living in any walk of life where she is able to do the work, and can be employed. But every man of age and experience knows that women are subject to disabilities to which men are not subject, and that they require greater consideration and a good deal more liberty in continuous or hard work than we are used to giving men, or that we in practice find requisite. Some of you seem to have mistaken the opinion Mr. Mallins has voiced at this meeting. In Liverpool, from the early tramway days, a number of women have been employed in the service, though we have not put them on the cars as conductors, and when people stand up here and say that they think that Mr. Mallins is wrong, they might at any rate give him some credit for his nearly 40 years' service in the tramways of Liverpool, and the knowledge that comes from that long time. I also have more than 40 years' knowledge of Liverpool, and any of you who have been there, as some of you were a short time ago when we gave you a president of the Association, know that we have a Pier Head traffic which is subject to very great fluctuations. We have crowds of passengers and trippers of all kinds, and a great deal of that overloading of which Mr. Fell speaks occurs when people come in from New Brighton in the evening or on a bank holiday, or even with ordinary traffic in the summer time there are sudden and very heavy loads. Great rushes occur from the Pier Head to the cars. Therefore it is a question apart from the point of the steep gradients in Liverpool whether women are quite suitable for service on the cars, at any rate to the extent that some people, without our local experience, think they are. In other towns they may work under more suitable conditions. Our friend from Walthamstow, Mr. Murray, certainly draws a picture that makes our mouths water, when we come to think that they are unable to carry their traffic, that they overload, that they carry to the full limit of what they can do, and then have to leave people standing in the street. It is a state of things we should try to remedy by putting on more cars, and by getting some sort of labour to carry the job through. Now whilst he objects to boys, and we all know the disadvantages, it seems desirable, without experience of Walthamstow, to try boys thoroughly rather than

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leave people standing in the street. When a Commissioner of Police takes up the attitude of the Commissioner of Police in London, it is high time that this Association should help the managers throughout the country to get the right which tramways committees should have of licensing their own conductors. It is a point which is worthy of great consideration. I do not quite follow Sir John Courtis, who believes so much in efficiency, when he doubts how the skirts are going to be satisfactory for women conductors in cold weather. It would appear that that point can be fairly met with short skirts and gaiters of a proper design and carefully selected material. If you employ women they should be properly and suitably dressed for the work on which they are engaged, so that they can do that work under the very best conditions. But I am a little disappointed that Mr. Dalrymple, to whom we are greatly indebted for his able paper, has not dealt with the question of economy at greater length. Mr. Lloyd George told us early in the war that it was the silver bullet that was going to win. Right through the municipalities of this country war bonuses have been given, wages raised, and anything done but practical economy. Right through the Government departments the same things have occurred, and whilst recognising the great strain upon them, if necessarily extravagant at times they have been at others unnecessarily extravagant.

The PRESIDENT.—I think the financial side of the question might be discussed on Mr. Baker's paper this afternoon.

Alderman SMITH.—It may be so, but I understand that Mr. Dalrymple's paper is on the subject of tramway labour problems as affected by the war. Labour problems are very much affected when you have 3,000 or 4,000 men as we have in Liverpool, and if you give them a few shillings a week more, then economy is one of the questions to be considered. Economy is a most unlovely virtue, I quite agree ; it is a nice thing to talk about, but it is beastly in practice. (Laughter.) However, it is right that the majority of the gentlemen holding important positions and conflicting opinions should, with the representatives of so many cities and towns, take this question soberly into consideration, and whilst doing justice to their men and their employees, should also strive to do justice to their citizens, who now have a big strain put upon them. That strain now only commencing, may hereafter be very great and burdensome.

Mr. A. R. FEARNLEY (manager, Sheffield Corporation Tramways).—I desire to add my thanks to those of the previous speakers to Mr. Dalrymple for the lucid and interesting way in which he has introduced this important subject. He started by a reference to the question of women conductors. When this matter got serious with us in Sheffield I went to Glasgow, saw what Mr. Dalrymple was doing and came back quite satisfied it was a simple proposition. We immediately commenced to introduce women conductors in our city, and now we have got 300. We have never had the slightest reason to regret the step we took, and we are adding to the number each week. I would say, if actual experience is of any benefit to the members, that I think the most important part of the work is in the selection of the women. When we commenced I had to choose the members of my staff who should select the women. I found a great deal depended upon that, and I selected two members of my staff who had had a great deal of experience in engaging men and in traffic matters. We decided upon the class of women we would employ, the ages, etc., and we have found that if we are careful in the selection of the women we have very few indeed to dispense with. The women we employ do their work exceedingly well.

A DELEGATE.—What are the ages ?

Mr. FEARNLEY.—The ages we set out for are from 24 to 35. We have now engaged some a little younger, and have got excellent women conductors at 21 and 22. There has been no difficulty in regard to the number of applications. The only difficulty has been to head them off. They have used all sorts of devices to get into the service, and when we made it a rule that as far as we possibly could we would take no domestic servants, we found that the servants would give up their situations, be out of work for a week or two, and then come and apply for a job on the tramcars. When we saw these girls and talked to them about this sort of thing, they said that under no circumstances, if they could possibly help it, would they go back again into domestic service. The wages we pay the women conductors are the same as the men start with, i.e., 6d. per hour. The hours are also the same as those of the men, except that we give the women double relief time ; instead of 45 minutes we give them 90 minutes, and we find that an advantage. Another great assistance we have in dealing with the women is that in the centre of the city we have a large club-room especially set apart for the women conductors. There is a large dining-room, with a cook and stewardess, and a large rest-room or sitting-room—a club-room if you like—with newspapers and easy chairs, where the girls can spend a comfortable hour after their meals, and they find it a great help in their work. We have made further use of the club-room by placing a woman cashier there, and she takes the coppers from the women, so that they have not to do the whole duty of eight or nine hours carrying about a day's receipts. We recognised that copper is heavy, and that it was a difficulty we should have to deal with, and we found this an easy way of getting over the trouble. With regard to uniform, we provide a blue serge tunic and skirt, a straw hat for the summer and a waterproof hat of Paramatta mackintosh for the winter. In regard to difficulties raised by the men, I may say that in Sheffield we have not had the slightest difficulty. One Sunday morning I got a message at my house that the men would like to see me ; they made complaints with regard to the long working hours and the relief time being too short, and they wanted some alteration. I said that there was an alternative, and that alternative was the employment of women. I proposed there and then that if they agreed I would recommend to the next meeting of the Tramways Committee that women should be employed, and they raised not the slightest objection. The only question they asked was what wages the women would be paid. It was a fair question, and they got a fair answer. With regard to the remarks made by the representatives of Liverpool, I want to say that I cannot agree with Alderman Smith in this instance, and I think his friend Mr. Mallins is entirely wrong. In Sheffield we have steep gradients, as steep as any in the country—some so steep that the Board of Trade in the first instance prohibited double-deck cars on them. The gradients are such as 1 in 9·6, and those were the routes on which we put the women. We have never had the slightest difficulty ; on the contrary, we have had every reason to congratulate ourselves. Only yesterday at the Council meeting, Sir William Clegg, the chairman of the Tramways Committee, announced the presentation of a sovereign to a girl who, when the motorman at the front failed, and the car began to run back on a gradient of 1 in 11, promptly put on the sand, applied the slipper brake, thus assisting the motorman, and so they pulled up the car. It is a matter of great astonishment, both to the management and the staff, and the whole of the city of Sheffield to see the efficient manner in which these women are carrying out their duties. Of course there are one or two little weaknesses—weaknesses are not peculiar to women ; some of those weaknesses we have got ourselves. One failing is they are inclined just to stay a little behind time ; they have something to say to the other woman, and they mean to say it, and stop till they have said it. The best remedy we find is a woman inspector ; she knows their weaknesses. She says, "Come along at the right time," and when that has been done we find it is a great help in working the system satisfactorily. We have appointed a woman inspector on each turn, and have found them very useful indeed, and they are doing good work. The training is carried out very much in the same way as at Glasgow ; for the first week we pay them £1. After the first week we pay them 6d. an hour. Another great help is an arrangement we have lately introduced in order to get over the difficulty of these girls having to walk home late in the evening or in the early morning. It was no easy problem to send out of the depot 150 women at 12.30 a.m. to find their way home. So we run a couple of staff cars, and if necessary we shall introduce staff cars to bring them down in the morning. With regard to missing duty, I can say that they do not miss their duty any more than the men. The other Sunday I spent the morning at the depot where 100 women took duty ; there was only one woman who missed duty and only one woman late, and that was on a Sunday, so I do not think that there was very much to complain about. In regard to Mr. Fell's statement, we are in the happy or unhappy position in Sheffield of having to deal with a 25 per cent. increase of traffic as a minimum each week over the corresponding period of last year. That, you will agree, is an abnormal state of affairs. I do not know anyone who has had to deal with such an increase. At this moment we are dealing with it as easily as if we had men conductors. We have few complaints. The women conductors do their utmost to pick up the last passenger. They do not trouble about anything, but bustle through the car. The men do not cause any trouble, and we find that the workmen will often help the girls. If they see a man trying to dodge the fare they round on him, or if they see one bring out half a crown they will tell him to put it back and get a penny. We find that sort of thing in Sheffield, where the public are exceedingly helpful in these little difficulties. As to Mr. Fell's remark about women conductors only being employed on trailer cars or single-deck cars, I may explain we started the women on single-deckers, and the girls asked why they could not be put on the double-deckers. They said we want to do the work of the men, so we gave them the double-deckers, and they did the work exceedingly well. I will just make one remark with regard to Mr. Dalrymple's reference in regard to the sheds. The more serious difficulty is with the workshops and sheds than with the traffic. We found that the munition work took away our foremen, our leading hands, and our charge hands in almost all our shops. They were offered practically double the wage we could afford to pay them, and the men, of course, took the positions, so that now we are working with a staff which in some instances is only 50 per cent. of what it was twelve months ago. All who have any experience of traction work know that sooner or later that reduction is bound to show serious effects, and leave its mark on the rolling stock. All I hope is that when it does begin to show the public will not grumble. There is a tendency for them to forget that we are working under war conditions. I am extremely obliged to Mr. Dalrymple for the way in which he has introduced this question.

Alderman G. BANTON (vice-chairman of the Leicester Corporation Tramways Committee).—I think that the experience of those cities where they have engaged women conductors will be very helpful to us. This seems to be the one question to-day in tramway

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undertakings —how to fill up the gaps made by those who have joined H.M. Forces, or who have gone on to munition work. This discussion was introduced along the line of finding substitutes for efficient men, but everything that we have heard stated seems to show that the women can do even better than the men have hitherto. The one dangerous note that has been sounded came from Leeds, and at a time like this. The dangerous thing is to engage women with the main view of economising in wages. It will not help us if that emanates from this congress to those towns willing to introduce this system. You will find that instead of having men's allegiance and willingness to work with women, they will be straight away up in arms against it. They will find that is the idea underlying the change, and I personally am one who would oppose such a system being introduced with the object of cutting down wages. You will not then have efficient working ; it will not tend towards efficiency at all. The times are changed ; there is labour unrest without a doubt, and if it is found that the main object underlying the movement is economy and for a reduction of rates, then instead of helping towns who want to have the change, it will only hinder them. The whole conversation this morning shows how deep is the interest in this question of women's labour. It has been stated that towns where women are at work cannot afford to pay the same rates the men are paid. Now I come from Leicester, where there is a great amount of female labour engaged. I would say that those women are paid the trade union wage, the same pay that the men have for similar work done. Leicester can do it and we all ought, as tramway controllers, to do the same thing. We are not under the same conditions as ordinary competitive enterprise ; but we are working for the public service, and if we are going to get efficiency from the women by all means pay them honourably.

Bailie R. KIRKLAND (Glasgow).—I have been very much interested in the discussion. In Glasgow we have made this experiment and it has been an unqualified success. I think that the principal reason is that when we decided to experiment with women conductors we resolved to pay them the same wages as the male conductors. There were two things which resulted from that. First of all, we had no difficulty whatever with our male employees ; they took no exception whatever to the employment of women, provided we paid them the same wage. Another result arose from that ; Mr. Dalrymple stated in his paper that he had received 12,000 applications, and of that number he has only engaged 800, something like 7 per cent. The reason for that is that he has fixed a very high standard, and no doubt the fact that he was going to pay 27 shillings a week was the cause of so many applications being received. I do not think that in Glasgow it can be said when we get 12,000 applications and only take on 800 that we are interfering very much with female labour in that respect. I was surprised at the statement made by my friend Mr. Mallins. He asked what we should do when these men came back ; what would happen to the places taken up by the women. It was distinctly understood and laid down in Glasgow that for those who had joined the colours and who were fortunate enough to return every man's job was there waiting for him, and it is also explicitly stated to everyone who is taken on during the war to replace the men who have gone to the front, that their services are only temporary. That is distinctly understood.

Mr. C. W. MALLINS (Liverpool).—On a point of order, sir, I just want to make it clear. There is no doubt whatever that everyone intends to take the men back when the time comes, but the point I did want to make was what was to become of the women ?

A DELEGATE.—Or the men ?

Mr. MALLINS.—What is to become of the army of women ?

Bailie KIRKLAND.—No doubt the women can go back to the employment they had before they were taken on during the war. Another point I want to make in connection with Mr. Dalrymple's paper is this—a week ago the receipts of the Tramways Department in Glasgow had reached a record. It was a surprise it was so, considering the depletion of the staff. I think I am right in saying that while there is a depletion in the staff of the Glasgow Corporation Tramways, there is little depletion in the traffic department, owing to the women, and the revenue is higher because we have more cars running. Now this is at a time when a depletion exists in every department but the traffic department. I may conclude, Mr. Chairman, by saying I have listened with very great interest to the discussion, which I am certain will be profitable to us all.

Captain T. PRESTIGE (London County Council). —May I move a resolution ?

Councillor R. T. BISHOP (vice-chairman of the Walthamstow U.D.C. Tramways Committee). First of all, let me thank Mr. Dalrymple for his offer of assistance to the London tramway authorities. I should like to accept his offer, and hand our tramways over to the Glasgow Corporation Tramways Committee and let them deal with the Commissioner of Police if they can. I can give you an instance of licensing difficulties that arise in Walthamstow. We applied to the police for licenses for two men who were quite efficient. They kept us waiting 14 days —14 days in one case and 9 in the other. As the men were efficient we put them on without their licenses. What happened ? They summoned both the manager and the two men.

A DELEGATE.—What happened then ?

Councillor BISHOP.— I am pleased to say that the magistrate was a sensible man and refused to convict. (Applause.) There is one thing I would like Mr. Fell to tell us—I am an amateur compared with that experienced tramway manager. He told us that the Commissioner of Police had done all he could for us—that is how he put it —and that he allows us to overcrowd our tramcars. I would like to ask Mr. Fell through you, sir, whether he considers that an advisable thing. Personally I do not. A suggestion has been thrown out, I believe, that we should pass a resolution, and with your permission I will move one. I do not know whether I am in order.

The PRESIDENT.—Any resolution to be moved ought to be sent up for our consideration, and should be in writing.

Councillor BISHOP.—The suggestion was that the Association should pass a resolution ; permit me to read it : " That after hearing the reports of the various tramway authorities as to the absolute success in the employment of women conductors in their systems throughout the country, and being convinced of the absolute shortage of suitable men in the metropolitan area, this Association calls upon the Commissioner of Police to reconsider his decision not to license the women in the metropolitan area." (Cries of " No, no.")

The PRESIDENT.—I do not think that would be wise. I think the Executive Committee are not unwilling to come to your assistance ; they are going to help you.

Councillor BISHOP.—That is all the London members ask. Perhaps Mr. Prestige's resolution would meet your views better than mine. But still allow me to thank Mr. Dalrymple. Walthamstow has already approached the Home Secretary, who, I believe, is the master of the Commissioner of Police.

Captain T. PRESTIGE (vice-chairman, London County Council Highways Committee). The resolution which I suggest is this, " That this meeting of the Municipal Tramways Association hereby instructs the Executive Council to approach the Home Secretary with the object of urging the removal of the present restrictions as to the employment of women as tramcar conductors in the metropolitan area."

The PRESIDENT.—If you will alter " instructs " to " requests."

Captain PRESTIGE assented.

Mr. L. E. HARVEY (manager, Ilford Urban Council Tramways).—I should like to second that resolution, and in a word to associate myself with the remarks of Mr. Murray, of Walthamstow, whose system is comparable with ours, and is labouring under the same difficulties. When I tell the Association that we have had many men week after week working 70 or 80 hours, and with no rest day off for two or three months, I think they will agree that it points to the necessity for bringing pressure to bear.

Mr. W. J. SQUIRES, J.P. (London County Council).— May I be permitted to support the resolution up to a certain point ? I think it is quite right that you should have the powers that you are seeking, and discretion can then be used by each tramway authority as to whether women conductors are to be employed. I know that there is very great difficulty. The manager for Sheffield, Mr. Fearnley, has told us how skilfully these women have handled the cars on emergency. With the information which we have received from Glasgow, Sheffield, and other places, I venture to say that there is a question which must be taken into consideration, namely, when are those powers to be extended elsewhere ? It has always been forgotten in provincial towns and cities that London is not in the same position as they are. The police here are the real authorities, whereas in provincial cities the municipal councils themselves rule the police, so we have in London very great difficulty. I am sure everyone in this conference to-day will extend to the London County Council tramways administrators full sympathy in the troubles which they have been going through in the last few months. Again permit me to congratulate Mr. Dalrymple on his excellent paper ; I am very glad to have been present. I only came up from Brighton this morning, and I ventured to take stock of the female labour problem there. I do not know whether the Brighton tramways manager is here, but I can congratulate him and the Tramways Committee on the way the women do their duty as conductors. What can be done at Brighton can be done elsewhere. (Applause.)

Mr. PETER FISHER (general manager, Dundee Corporation Tramways, and President-elect of the Association).—I am not going to say anything about the resolution, but the experience we have had in Dundee may to some extent support the resolution which has been submitted to the meeting. We have not employed women for very much the same reasons as those explained by Alderman Brown, of Leeds. Women's labour is scarce in our city ; they are importing females from other towns for munition work, and consequently it would be almost out of place for us to encroach upon that source of supply of labour. We have tried in every way we can to meet the shortage. I will tell you what our experience has been. A third of our employees enlisted. A further number left for munition work ; some on the traffic staff, others in the workshops went on munition work. We have never taken on a man since the war broke out who was suitable for military service. We take on men over military age, and of those men no less than 60 per cent. have failed ; they were absolutely unsuitable for tramway work ; bad habits, unsteadiness - I do not say altogether in drink —but in not turning up to their work ; they simply did not appreciate what

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it meant to be regularly at work. In addition to the number of men who enlisted, there were a number, equal to about 17 per cent., of our staff who have left us and undoubtedly gone into other employment. Most of them were men of military age, and I believe they have not offered themselves for military or naval duty, which shows that other employers are not doing what we are doing; they are employing men of military age. I have been trying to ascertain where our men are who have gone away. They have not gone to better positions. I am sure that the fact of our men being so prominently before the public probably caused them to feel not in the right place when working a tramcar. They have gone away to other work. Men enlisting and those going as munition workers have depleted our staff to an enormous extent, and I was going to explain that we have come to the conclusion that there is not a sufficient supply of male labour to carry on our business with anything like the usual efficiency. I think our experience in Dundee may therefore to some extent strengthen the motion that is at present before you.

The Hon. Secretary.—I do not think, Mr. President, having regard to the hour, that it is necessary I should say anything; I did want to say a word, but I will only read the resolution.

The President.—Before putting that I should just like to say one word in regard to Salford. There we have from 70 to 80 female conductors. Like Mr. Dalrymple, I am not going to make any comparison between the women and the men, but I want to say this, as far as the money goes they have given exceeding satisfaction.

Mr. Alfred Baker.

With regard to the dress for the winter, we are providing them with a great coat—a good warm coat. There is some idea that women cannot stand the strain of this work as well as men, but I may say this, comparing the sickness of the males and females, it is very much greater among the males than among the females.

Captain Prestige's resolution as verbally amended was then put and carried unanimously.

Councillor S. C. T. Newman (vice-chairman, Bradford Corporation Tramways Committee).—The hour for the adjournment has already arrived, and I do not propose to detain the conference for more than a moment. But I feel that we have a duty to perform before separating, and that is to pass a vote of thanks to Mr. Dalrymple for the excellent paper he has given to us. I do not know that I ever listened to a paper with greater interest than his, and probably that is due to the fact that it particularly appeals to the layman with authority, because it is delivered at a time when exceptional circumstances render a paper of the kind necessary. We ought to feel infinitely indebted to Mr. Dalrymple for giving us the benefit of his experience on this most thorny and debateable point, because no doubt those who have already followed the lead of the Glasgow Corporation Tramways Committee will fortify themselves in the action they have taken, and those municipalities who have not done so will find in it great assistance, if ever they should find it necessary to face a similar policy.

The vote of thanks to Mr. Dalrymple was accorded with hearty acclamation.

AFTERNOON SESSION.

The President again took the chair at 2 p.m., and called upon Mr. Alfred Baker, who introduced the discussion with following paper:—

FINANCIAL PROBLEMS AS AFFECTING TRAMWAYS DURING WAR TIME.

By Mr. Alfred Baker.
(*General Manager, Birmingham Corporation Tramways.*)

In the early days of municipal tramway history, when local authorities were commencing to work their own undertakings, it was, in most cases, laid down as a broad principle that municipal tramways should be run as commercial concerns and on strict business lines. It is true that in some places the opinion was held that it was neither desirable nor necessary that municipal tramways should make large profits, but that so long as the undertaking paid its way and did not involve a rate in aid from the borough funds, "users" should have all the advantages of frequent services and rapid transit at the minimum cost. Others, being merely ratepayers who "back the bill" and only use the tramways infrequently, thought it unfair that users should have all the advantages, but that after keeping the concern in a sound financial condition, substantial sums should be handed over each year for the relief of the rates.

There is a great deal to be said for both these views—and, generally speaking, municipalities have struck the happy medium, and have been able to give frequent and reasonably cheap services as well as considerable sums to the credit of the borough funds. For a number of years everything has gone well with municipal tramways; good profits have been made, depreciation funds, more or less adequate, set up, large amounts transferred to relief of rates; excellent services have been given, enabling suburban districts to be opened out, wherein workmen have been able to live in comfort and decency; congestion in large centres has been relieved, people have been carried to and from their business cheaply and expeditiously, and it is fair to say that the majority of the undertakings have been maintained in a sound financial condition. All this has been accomplished on scales of fares established in the majority of cases when the municipalities first took over the operation of tramways.

It must be confessed that committees in "fixing the fares" dealt very generously with the travelling public; indeed, in some cases Corporations seemed to vie with each other as to who should give the longest ride for a penny fare. Compared with the fares charged by companies who in some instances had previously operated the lines, the Corporation fares were less than half. Many towns gave an average of 2 to 2½ miles for one penny, while others gave nearly three miles. On top of these cheap fares, concessions were given to workmen and other classes of the community. Wages also were fixed liberally, as compared with what had previously been paid.

In the flush of success and on the strength of "these excellent returns," some of the municipalities I am afraid rather light-heartedly granted concessions here, there, and everywhere without counting the cost. In any case, it is an undoubted fact that expenses during the last three or four years have gone up very considerably. Constant demands have been made for increases in wages owing to the extra cost of living, etc. Prices of materials have largely increased, and many of us began to look at the financial situation somewhat anxiously even before the war broke out. Since the outbreak of hostilities the situation has of course been much worse—still higher wages and war bonuses were demanded and given, besides which in many towns allowances have been made to the dependents of those tramway men who have joined H.M. Forces. All these items have increased the cost enormously.

With regard to allowances to dependents, to give the figures of a few of the largest towns only—Glasgow will pay this current year no less than £66,000; Manchester £70,000; Birmingham £36,000; Liverpool £35,000; Sheffield £11,500; Leeds £7,570.

With regard to the cost of materials. Examination of Birmingham figures shows that the cost of stores and materials used in connection with the tramways, leaving out of consideration permanent way materials, has gone up all round by at least 27%. To give a few of the principal items will show how severely tramways have been hit:—

	Increases
Iron and steel bars	60%
Trolley wire	30%
Oils and greases	10%
Steel tires	80%
Malleable iron castings	20%
Car Furniture	10%
Timber	30% to 80%
Brake blocks	25%
Trolley wheels	10%
Gun-metal castings	15%
Glass	25% to 50%

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Then with regard to wages. I have already stated that these have been steadily forced up, and here again Birmingham figures are perhaps indicative of the experience of tramways all over the country. I find that the wages of our traffic and permanent way staff since 1913 have increased by 10 per cent., while the increase to men in the skilled trades has been no less than 8 per cent.

Then there is the item of rates and taxes. The tendency all over the country has been in the upward direction—I am not sure that figures relating to any particular concern can be said to apply generally—but for the sake of information I give you the following with regard to the Birmingham system :—

LOCAL RATES.

1912–1913	£20,218
1913–1914	£30,790
1914–1915	£42,093

From the above figures it will be observed that the local rates have more than doubled themselves in the last three years. This is mainly due to the revaluation of the undertaking, whereby the assessments were increased by 100 per cent.

INCOME TAX ON PROFITS.

1912–13, the undertaking was assessed at £146,586, and the tax at 1s. 2d. in £ ...	= £8,551
In 1913–14 the assessment was £152,137 and the tax 1s. 2d. in £	= £8,875
In 1914–15 the assessment was £148,445 and the tax 1s. 8d. in £	= £12,370

Assuming the amount of assessment for 1915–16 to be the same as that of last year, viz., £148,445, the tax which has been increased to 2s. 6d. in the £ will be £18,556, or an increase of £10,000 over that of 1912–13, although the amount of assessment has not been materially altered.

The net result is that working expenses and dead charges in Birmingham, as shown by our last accounts, got perilously near the point where they balanced the receipts, as shown by the following figures :—

Year.	Receipts.	Expenses and Dead Charges.	Depreciation.	Surplus. To Relief of Rates.
1912-13 ...	£581,566	£485,794	£45,000	£62,248
1913-14 ...	£635,470	£507,788	£31,000	£45,168
1914-15 ...	£647,014	£604,844	£17,596	£30,130

It will be noted that the amount carried to reserves for depreciation dropped from £45,000 in 1912–1913 to £17,596 in 1914–1915. If justice had been done, the whole of the £47,000 last year would have been carried to reserve fund, but Birmingham, like other towns, possesses a Finance Committee, who generally want at the end of the year more than in the previous year to help "keep down the rates."

This is extremely unfair to the trading concerns, as well as being very bad finance. Funds for reserve and depreciation ought not to be starved for the sake of keeping down the rates. It is false economy.

It is clear that the financial problem so far as Birmingham is concerned was becoming acute, and the question arose as to the best way of meeting it. It seemed to me that there was only one way and that was to increase the selling price of the article we had to offer, viz., the tramcar ride. The cost of production, as I have shown, has gone up enormously, then why not raise the price of the article? Tramways are as much a business as gas or electric light. The various gas and electric light undertakings in the country have not hesitated to raise their prices on account of the increased cost of production. Why not tramways? I have heard it suggested that instead of increasing the selling price, the first effort should be in the direction of economy in expenditure. Reconstruction of track should be put off until more favourable times, repairs and painting of rolling stock should be reduced to the minimum, depots might be neglected for a year or so, and so on. We who are engaged in the operation of tramways know that economies in these directions would be of the falsest kind, and would only result in increasing the financial difficulties by setting up a store of liabilities which would probably never be written off.

In due course the suggestion to put up the selling price was submitted to my committee, who, when the situation was placed fully before them, as prudent men of business, saw the wisdom of it. Something had to be done, and failing anything better the matter was gone into thoroughly, and eventually a new scheme of fares was got out and submitted to and approved by the City Council practically without dissent. This new scale reduces the length of the first penny stage from the centre of the city from an average of 2½ miles to an average of 1⅞ miles. The 1½d. stages have been increased to 2d.; the 2d. stages to 2½d. The workmen's 1d. return tickets have been abandoned. Owing to the difficulty in obtaining the new tickets, it was found impossible to put the whole of the new fares into operation at one time; we therefore divided the system into four parts, and introduced the new fares in sections. The whole of the new fares were got into operation in about one month.

Naturally this innovation was looked upon by some critics with a good deal of cynical surprise; many doubted the expediency, and some said openly that it was an "awful mistake" and that the financial position of the undertaking, instead of being improved by the change, would become much worse; many people would prefer to walk, others would cycle, and the remainder would be driven to the trains. What has been the result? In the first place there was no grumbling on the part of the passengers, which shows what sensible people Birmingham citizens are. They recognised that fares, like everything else, must go up, and they cheerfully paid their extra halfpenny; and, secondly, that the venture was proved to be thoroughly justified. The following figures show this:—In August, 1914, our receipts per car-mile were 10·17d., while in August this year they were 13·18d., an increase of 3d. per car-mile.

This, however, is not a fair criterion. In August, 1914, when the war broke out, there was something in the nature of a panic, and receipts were down everywhere.

It is safer therefore to take as a comparison the earnings of June this year, and compare them with the receipts for August, the first month of the new fares, when we get the following results :—

June, 1915 ...	... 11·69 per car-mile.
August, 1915	... 13·18 per car-mile.

an increase of 1·49d. per car-mile, or £1,666 per week.

Referring to the June figures of 11·69d. per car-mile, it may be said that these were good enough, and higher than the average of many towns in the country. This would be so under normal conditions, but I may point out that this high average is produced by overcrowding, owing to a reduction of 10 per cent. in our services, which would never be tolerated if it were not war time.

It may be suggested the fares will have to be reduced to their former level after the war. There would be some force in this if at the same time wages could be put down again, but who believes that the increases in wages granted on account of high cost of living will ever go back to the old level? Or does anybody suggest the war bonuses will ever be withdrawn? Personally, I don't think so. War bonuses in the majority of cases will be claimed as wages when there is no war. The war allowances to dependents will, of course, disappear, but there will remain certain responsibilities with regard to wounded and disabled soldiers which are sure to keep expenses up. Further, it may be argued that, generally speaking, traffics are higher all over the country than ever, particularly in manufacturing areas. This is undoubtedly true. Then the question is asked, why raise the price? My reply is this, we have raised the price while the money is about. There will be a tremendous slump when the war is over. Money will be scarce. It will be impossible to put fares up then. In any case, we've got the money now; nobody has felt the change, and whatever happens after the war we shall be at least £70,000 or £80,000 better off this year.

THE DISCUSSION.

The PRESIDENT.—I hope we shall have as good a discussion on this interesting paper by Mr. Baker as we had on Mr. Dalrymple's this morning.

Mr. C. W. Mallins (manager, Liverpool Corporation Tramways).—I am sure that we are all deeply indebted to Mr. Baker for his excellent paper. It is certainly a very commonsense paper, and I believe has given us a lead in a particularly important matter. We had a good deal of discussion earlier in the day upon another subject, but I think this is a matter which requires the close attention of everyone at this conference, because there is no doubt, as Mr. Baker rightly points out, that in the early days of electric traction we commenced on conditions that were not financially sound. That, as he says, it was a questionable policy subsequent years of experience have very fairly demonstrated. I think there was a great deal of truth in the statement, and we are greatly indebted to Mr. Baker for striking a note of warning. We will all be well advised to look carefully into his suggestions and adopt them if they are in consonance with our own particular systems. I should like to compliment Mr. Baker on his paper, as I am afraid I differed from the greater part of the members earlier, but I am thoroughly in accord with what is contained in the present paper. (Applause.)

Mr. A. ELLIS (general manager, Cardiff Corporation Tramways).—Mr. Baker's paper is of such a nature that it leaves little room for discussion. There is hardly a point he has touched upon that we can argue with him. I entirely agree with him in regard to raising fares, etc., but in an important city like Birmingham where their methods of finance are well known, I should have thought that in connection with their tramways undertaking particularly, before considering for a moment the relief of rates, they would have considered the payment of a sufficient sum of money into the depreciation and reserve funds. No doubt Mr. Baker will agree with me in what I am going to say. Whilst during the year 1912–13 a sum of £45,000 was required for the depreciation fund—it might be a little in excess, but I take it that they then put by something which was a proper amount—it is a great mistake that in 1914–15 the amount should be cut down to £17,596. It simply means that at a later stage there will be a lot of arrears to make good. Mr. Baker has pointed out, and I agree with him, that expenses are not going to show any tendency to lessen after the war. The men, as he has indicated, are not going to forego the war bonus very readily, whilst in some cases the payments to the dependents of those who have joined H.M. Forces may be converted into payments to dependents of men

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disabled as a result of the war. I think that in Birmingham they have taken a wise course by increasing the price of the article which they sell, in view of the increased cost of the production of such article. I think it is a reasonable course to take, but once the charge is increased, I should naturally endeavour to maintain it and not be in too great a hurry to reduce it. In the city which I represent we are not so much troubled by the Finance Committee as Mr. Baker appears to be in Birmingham. The reason is that the Finance Committee in Cardiff have endorsed the views of the Tramways Committee, in determining that before any relief of rates from tramways is considered—and we have relieved the rates during the past few years, though not this year—that the depreciation fund and the reserve fund should first of all be secured. I think this is a wise policy to adopt. There is another point I should like to mention. I submit that if you economise on the maintenance of your cars, you are going to create discontent amongst the passengers, and also accumulate an enormous amount of work in the near future which you will never be able to get over except at considerably increased cost.

Alderman R. A. SMITHSON (chairman, Leeds Corporation Tramways Committee).—I agree with previous speakers as to the useful and very interesting nature of the paper which Mr. Baker has submitted, but I hope that succeeding speakers will not adopt the tone of those who have already spoken. The discussion seems to have taken a rather too pessimistic view of tramway undertakings, even in abnormal times like these. We are, perhaps, apt to exaggerate our troubles. The impression which I gathered from the remarks of one or two previous speakers was that the basis of fares fixed by municipal tramway undertakings had mostly proved to be fallacious and misleading. I think this is a misleading statement, because if we take the trading of the tramway undertakings throughout the kingdom as a whole, the fares fixed, the length of the stages, etc., given by municipal tramway undertakings have been amply justified. The results have proved in the main that the municipalities adopted a wise course in offering very excellent travelling facilities. The travelling public responded to that, and they have made these undertakings on the whole quite sound and prosperous. We are all, I think, too much inclined to go to extremes on the subject of depreciation, and to urge that we ought to put by larger sums for depreciation than is really necessary. Mr. Baker quotes his figures for depreciation, i.e., £45,000 in 1912–1913, which was reduced to £31,000 in 1913–1914, and to £17,000 odd in 1914–15. May I ask managers, who I know are most keen- and naturally keen--on having a large depreciation fund, to consider the fact that in later years it may be that depreciation is less needed than in the earlier ones. In the earlier years little expenditure in repairs and renewals may have been required, while in later years very much greater expenditure may have been incurred, which brought the undertaking up to a high pitch, so that subsequently the provision for depreciation is less necessary. Mr. Baker's figures of expenditure are, of course, grouped together, and I have no means of dissecting them to see how much of the expenditure in those years was devoted to repairs and renewals; but comparing the increase of expenditure and the increase in the receipts, one may fairly assume that the expenditure on repairs and renewals has gone up quite out of proportion. In the earlier years, rolling stock, track, and everything else was comparatively new, and did not require a great amount of expenditure; and I think you might bear these things in view and not take a too pessimistic view of our tramway undertakings in war time. I rather thought that Birmingham Council had succumbed, in pure selfishness, to the temptation to collar the money whilst it was there and they could get hold of it; and when I heard that the public had responded to the increase without a grumble, I wondered whether I was listening to a sober financial statement or to a fairy tale of a bygone age. I cannot imagine fares in Leeds, Bradford, or other Yorkshire towns, being increased to anything like this extent and being received by the public without a murmur. It is beyond me. I will talk to Mr. Baker later on and ask him to tell me what pill he administered to the Birmingham public to get them to accept the treatment; but at the present moment you must excuse me for declining to believe that it would be possible for Yorkshire. Whilst it is quite useful to consider the effect of war conditions on tramway profits, on tramway expenses, and on tramway undertakings generally, at the present moment I think it is rather futile to try and form any sound judgment as to what is likely to happen in the future. It may well be that those percentages of increased cost which exist to-day may disappear altogether in the course of a year or two after the conclusion of this war; there may be rather a slump in materials and even in labour; it may be that in the future the expenses of working tramways may be less rather than more In the meantime, I think, whilst we may take every reasonable precaution, there is no object to be gained in taking a too pessimistic view of the future as it applies to our tramway undertakings. I have every confidence in them, and I believe that they will continue to enjoy the confidence of the public in their financial aspects as they have done in their physical convenience.

Bailie ALSTON (Glasgow).—I thoroughly agree with the last speaker in relation to the view he takes of the abnormal circumstances we are in at present. I think the increased cost both of working and of expenditure in relation to the war are abnormal conditions that certainly we have no right to expect after the war. I was rather surprised to hear the statement at the start of the paper that the Finance Committee of Birmingham was such a tyrannical committee, and that it decided the destinies of the finance of the tramways. I rather think if the Finance Committee of Glasgow were to try to say to the Tramways Committee that they were going to deal with our finance in such and such a way, that the Tramways Committee would in all probability tell them to mind their own business, and that we would arrange the finances of the tramways to suit that department. I contend that there is no right on the part of any trading department to contribute to the rates as long as a single penny of indebtedness are outstanding to the public at all. I think the payment to the rates is a bad thing from another point of view. It is bad from the point of view of the department which contributes it, because it very often leads to a method of administration in that department that is altogether bad. Again, from the point of view of assisting the tradesmen, I think it is the worst form of finance that any public body can take up, because it invariably leads to a form of expenditure, if not reckless at least careless. The best form of assessment for that is direct assessment to the people, and if I were asked what form that ought to take, I should say assessment upon income and not upon rental. That may be heresy to ordinary accepted standards, I dare say, but I believe it is the true and accurate method of raising money. I regard a considerable part of the paper as a very bold article in favour of taking from the trading department for the purpose of relieving the rates. I hope that the note from this conference will be that they deprecate very strongly the system that has hitherto obtained of municipalities going to the trading department and asking for certain large sums for the purpose of relieving a burden that should be assessed for. We in Glasgow work on a somewhat different basis to the ordinary method of tramway administration; our tramways are a part of what we call "the common good." Any surplus goes into that fund, and may be used for purposes that we are not entitled to rate for. The surpluses hitherto have always gone there; this year our surplus is a very small one, owing to the abnormal times. I think that the reader of the paper mentioned that it has cost us some £66,000 for the purpose of dealing with our responsibilities in relation to the war. That is perfectly true. We also pay in rates, I believe, something like £80,000 per annum. That is for local rates, and we have every belief that Mr. Lloyd George and Mr. McKenna will come in this year and relieve us, it may be, of a very handsome sum indeed. These are large figures. I hope you will persevere and see that the first consideration of trading undertakings is that they are run on a sound financial basis, and that all that the depreciation fund and the sinking fund can rightly claim is duly paid before one penny is paid in relief of rates.

Alderman F. SMITH (vice-chairman, Liverpool Tramways Committee).—I have listened to what our friend who has just sat down has said, and I disagree with him absolutely. (Laughter.) I must congratulate the readers on the papers given at this congress on their pithiness and clear reading, and in the case of Mr. Baker on the admirable sheet illustrations he has given us in order to prevent our over-straining our intellects or worrying ourselves to get down accurately the figures which I trust will be useful to every member who has attended here to-day. The old question of whether you should or should not relieve rates I will dismiss with a very simple proposition as it appears to me. The ratepayer of to-day and of the days that have just gone has had the tramways constructed at his cost. (Hear, hear.) He is entitled to some relief from the profits that are being made, not to an unreasonable extent, but to a reasonable extent, so that the incoming man or ratepayer of a few years hence shall have an undertaking practically free from debt, but not entirely at the cost of the man who has gone before him. That seems to me to be the proper attitude of mind to adopt. I was a bit responsible in the case of the relief of the rates to Liverpool, and I intend so far as I can to insist upon some sum being given to the relief of rates. In regard to the course taken at Birmingham, I think it is an admirable method. The one clear exposition of Mr. Baker can be properly recommended to every municipal tramways in the country, that is to make a profit; if you are not making a profit, this is the time to put the fares on a scale that will make a profit now that money is about. Mr. Baker was perfectly true in saying that the fares have been decreased, the distances have been increased, the wages have been increased, and the hours shortened. All these things have been done, and it is from the little reduction in the distance many of us give for a penny or twopence that you can save enough to pay back some of the heavy charges that are now apparent, and some of the extremely heavy charges that you have got to meet in the future. If you do not do it now, as Mr. Baker has wisely pointed out with his far-seeing eye, you are going to have a time when you cannot do it, when you will have to face a loss that may come about, and a very heavy loss it may be. I hope he is wrong with regard to the question of the war bonus not being discontinued; I hope he is wrong in some of his other conclusions, but there is undoubtedly abroad a spirit of great extravagance which we call liberality. I told you this morning that economy is an unlovely virtue with my own money, and it is a still more unlovely virtue with public money. I am favoured with

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a very large circle of acquaintances in the city in which I have lived so long, and I know from direct statement and my own knowledge of the facts that the expenditure that we incur is very frequently extravagant and reckless expenditure. Perhaps it is unavoidable under the extreme pressure of the awful circumstances under which we stand, but it has got to be met. You may look for a long and arduous struggle, you may look for heavy taxation in every direction, and you may look for a continuance of the high cost of living. If you do not now as tramway men wisely take the view of Mr. Baker and his committee, and prepare for it, you will regret it in the time when you can no longer prepare for it, when you have got to face the results of your own inaction at the moment when action is necessary. I am not going to press it upon you. Mr. Baker has done that with great ability, with great care, and with great certitude. Here you have the figures; if you do not give heed to them then I do not imagine that you will give heed to anything I say. (Laughter and applause.)

Mr. J. M. McELROY (general manager, Manchester Corporation Tramways).—The principle which Mr. Baker has enunciated is, briefly, that the operating costs have been going up by leaps and bounds, therefore we ought to increase fares to make our net profit greater. I think we should be careful before accepting that as a safe general principle. When we look back we find that right from the start the cost of operating tramways has been increasing. We also find that in many large towns the average fare has been going down, and notwithstanding all this the average earnings per head of population has been going up. In short, whilst we have had increased cost of operation and decreased fares, we have had increased net results; so we ought to be very careful in accepting at this time as a general principle that to increase fares necessarily means that we should have increased net income. I am not speaking of Birmingham—there they will act under Mr. Baker's advice—but in Manchester we have decreased our fares from time to time, wisely feeling our way on each occasion, and our earnings per head of the population have gone up each year from the start. Not only in Manchester is it true that there is a growth each year in the number of rides per head of population, but it is true in every large city in the world. Look at the statistics of the American cities and the Continental cities. In each case you will observe a uniform yearly growth in the riding habits of the population. It is due to this that we have been able in the past to meet the growing expenditure; therefore I do not think it ought to go from this meeting that the right way to meet the difficulties through which we are passing at the present time is to increase our fares. We should approach this question with care and avoid panic legislation.

Mr. C. J. SPENCER (general manager, Bradford Corporation Tramways and hon. secretary of the Association).—I should like in the first place to express my personal gratitude to Mr. Baker for having come forward to introduce this very important and interesting subject in the clear and concise manner in which it has been done. I suggest to you that the most interesting portion of Mr. Baker's remarks is that, so far as I know, Birmingham is the first town which on any large scale during our time has adopted a policy of increasing its fares. We have heard at different conferences a good deal about the financial result of reducing fares, but here for the first time we have a large example of the policy of increasing fares. Mr. Baker has told you, I think, that the result of the policy has been to increase receipts; but if we carefully examine his figures can we quite accept that conclusion? I do not want to dispute the figures—I have not sufficient information to enable me to do so—but I ask whether the figures which Mr. Baker has put forward quite support the conclusion that Birmingham Corporation Tramways have benefited financially as a result of the increase of the fare rates. Mr. Baker first makes a comparison between August last year and August this year, in which he shows an increase per car-mile of over 3d. Now, Mr. Baker himself, after stating quite properly that last year was an abnormal period, and therefore that any comparison which might be made between it and this year would be a little invidious, proceeds to make his comparison between June, 1915, and August, 1915. I presume June, 1915, was prior to the increase in the fare rates, and that August is a full month with increased fare rates. Mr. Baker tells us that the effect has been an increase, roughly speaking, of 1½d. per car-mile in the receipts. Unfortunately that is complicated by another factor—that the car mileage is down considerably and considerable overcrowding is taking place.

Mr. BAKER.—Not in August; the same conditions, very much the same conditions, prevailed.

Mr. SPENCER.—If the same mileage was run in June as in August, and there has been an increase of 1·49d., then it must follow that the increase mentioned of £1,666 per week is a net increase of receipts. Is that the actual result, comparing one month with the other?

Mr. BAKER.—Yes.

Mr. SPENCER.—And not calculated from mileage?

Mr. BAKER.—Yes.

Mr. SPENCER.—So you show in pocket £1,666?

Mr. BAKER.—Yes

Mr. SPENCER.—If that is so, it supports the contention that an increase has taken place.

Mr. McELROY.—An increase of £1,666?

Mr. SPENCER.—Between June this year and August.

Mr. BAKER.—The increase between the present time and last year is running up to between £2,000 and £3,000 every week, but the increase in August, 1915, over June, 1915, averages £1,666.

Mr. SPENCER.—Then it must be clear that you have to put in your pocket, with the same mileage, the same expenses, apart from increased cost of materials, a sum of £1,666?

Mr. BAKER.—Yes.

Mr. SPENCER.—I am glad to be made clear on that point. My mind was hazy. I submit that is an exceedingly important result and worthy of your consideration. On the general wisdom of doing this from a profit point of view I do not propose to enter. Enough has been said on that, but I do not want anyone to go away from this conference with the fear that the tramway people of this country are singing a swan song. I do not think that tramway owners need be pessimistic as to the future of tramways. If they read the journals they will notice that tramway receipts, after 12 months of this most terrible war, are satisfactory. It is astonishing we have done so well as we have and are standing here as prosperous as we are to-day. We have a number of problems to face—I am not disagreeing with Mr. Baker's method of meeting them—but they are necessarily temporary problems and need not continue after the war. A lot of special legislation, tramway legislation, so far as we are concerned is bound then to take place. As tramway people we have, for 16 or 17 years, placed ourselves in the position of supplying a great public service, no less in importance than water, gas and other municipal commodities that are now supplied, and whatever happens our tramways will have to go on, and a revenue will have to come from the passengers who keep them going. As to whether the men will after the war demand wages level with what they are getting now, or more wages than they are getting now, that, I take it, is an economic problem. Whatever may be said now, or whatever may be said then, the old law of supply and demand will settle conditions again. Sooner or later we shall have to come back to that, and that will be the rock bottom of all our future fares.

Mr. H. MOZLEY (general manager, Burnley Corporation Tramways). Our idea in Lancashire is rather contrary to the doctrine preached by our Glasgow friends. In Lancashire we are reckoned a business people, and our idea is that the shareholders of the undertaking should receive a dividend of 3½ per cent. per annum, and they can use it in relief of rates or whatever they like. We do not consider ourselves in a satisfactory position until we are able to hand over to the Finance Committee 3½ per cent. on our capital expenditure, and no other view will appeal to our Lancashire men. With regard to contributions to the depreciation fund being continued during the war, I think in view of the future developments of our undertakings there is no danger whatever in suspending your depreciation account say for twelve months or two years, but mind you, that largely depends on what you have already accumulated during a number of years. If you are badly supplied with money for depreciation, it would be very unwise to suspend depreciation. But our policy has been to suspend the depreciation fund temporarily and allow the money to go in relief of rates. The town requires all the assistance towards the rates that the commercial undertakings of the Corporation can give them. With regard to fares, I think perhaps it would be better for me to keep silence, for the special reason that in the town I represent we did not make the mistake that has undoubtedly been made on some undertakings. But whenever the time comes to discuss the matter *in camera* I shall be very glad to take a share in it. We did not make the mistake of establishing a non-commercial, uneconomic fare; our fares are fair, and very satisfactory to the public, and particularly to the working people; and yet the fares we see in operation in such places as Manchester, Birmingham, Bradford, Sheffield, and other large cities would simply mean ruin to us if they were in operation in my town. We did not make the mistake, and therefore we have not got to eat the leek in regard to raising fares as suggested by our friend from Birmingham, Mr. Baker. Yet we do make mistakes even where I come from—(hear, hear)—and that is in regard to differential fares. My people are smitten with the disease of differential fares, and although it has not an important effect on the finances of the undertaking, it does affect and complicate the working of the system, and to that extent we are not as pure in regard to fares as we might be. With regard to the war bonus, what do you mean by saying that it will be claimed by the men when the war is over? There will be no resolution with regard to a war bonus, and it will automatically cease directly the war is over. (Laughter.) I am speaking technically; we have nothing to do with what our councillors and aldermen do, but if you do not pass any other resolution than you have already passed, the week peace is declared the war bonus will disappear from the pay sheets without a word being said to anybody. I am speaking technically. The rate of wages will be determined by law of supply and demand, and I agree with Mr. Spencer as to that. With regard to an allowance to the wounded, are we to undertake imperial duties everlastingly? We have taken on ourselves to make dependents' allowances, which is an imperial duty; I do not object if the Councils realise what they are doing in making these allowances to our employees. I think it is a very handsome thing to do, but have you considered the effect on men in the same trench from the same town, one man being paid his portion of the allowance and another man getting

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nothing? I think you must be just as well as generous. But to come and say that we are also to consider the position of the wounded and disabled men, that is a duty which distinctly belongs to the Government, and which they are already providing for, generously or not, I am not here to say. It is not our business; that is an obligation which you are suggesting shall come upon us. Why do you mention such matters now, and raise hopes that may not be realised? With regard to the income-tax, we all know that that is a sore subject just now; in fact, looking at the scale which I read is coming in, it is enough to make a man quake as to what is going to happen to himself. As a matter of fact, the income-tax is not a charge upon the undertaking, but upon the mortgagees largely. This money was taken out of our working expenses on settling the standard form of accounts, because it is not working expenses. We do not want to make too much of this large sum Birmingham will have to pay in income-tax as well as ourselves. I can understand it looks very big to some gentlemen, and it is the very small undertaking that these figures may alarm. Are we going to be worse off after the war? A good many of us were alive in 1870, and adult people even then—those who have good memories will know we had such an outburst of trade succeeding the great war of 1870 which brought much to this country, with high prices, high wages, and everything else. Why should we not have a very much larger effect in that direction for some years after war ends now? I say do not look at matters in a pessimistic way. Our tramways will benefit from that, and a good many are going to pay, and are going to pay handsomely. But I think that Mr. Baker has proved his case, that his additions to the fares have brought a net increase of revenue to the Birmingham Corporation, and those increases are quite true.

Sir JOHN COURTIS, J.P. (chairman, Cardiff Corporation Tramways and Lighting Committee).—In a few words I want to congratulate Mr. Baker upon his paper. With regard to Mr. Smithson's observations about depreciation, I should like to mention the experience of the city I represent at this conference. The tramways department have contributed for the last few years to the relief of the rates, but this year we have not been able to do so. We have been putting aside a certain fixed sum every year, which was arrived at by our City Treasurer from information supplied by the City Engineer, who deals with our track work. I think it has been mentioned at previous conferences, that some municipalities, Cardiff included, had a thirty years' loan on the track, but it is well known that the track requires reconstruction long before the expiry of that period. We have during the last year carried out a great deal of reconstruction work, and the cost has considerably exceeded the estimates given by the City Engineer a few years ago, upon which figures the amount set aside for depreciation was fixed. The result is that our depreciation fund has shrunk to a sum which makes it necessary to fall back on last year's profits to make good the extra cost of the work carried out during last year and the present year. Here is a case where, under ordinary normal conditions, we should have been contributing to the rates this year, but are prevented from doing so entirely in consequence of increased expenditure in the reconstruction of portions of the track, and also increased expenditure in maintenance of track. I am afraid I do not quite follow Mr. Smithson's argument about concealed profits. I know that very careful management is necessary to show any profit at all nowadays, especially when there is a large capital outlay to consider as in our case. I entirely agree with Mr. Baker in the conclusions he arrives at in his admirable paper. We shall have labour problems to face at the conclusion of the war, I fear, but it is perhaps unwise to forecast the future as regards the attitude which will be taken by the men when the question of bonuses given for the period of the war has to be considered, but, as Mr. Baker says, it is quite doubtful whether the men will be satisfied with any reduction in their wages, although the increase was given for a specific purpose.

Mr. J. B. HAMILTON (general manager, Leeds City Tramways).—If I rise to say anything I am sure Mr. Baker will not accuse me of hurting his feelings or decreasing the high esteem in which I hold him when I say that I quite disagree with the general tone of his paper. I think there ought to be a law against pessimism, and it is a most pessimistic paper all through. (A Delegate: "A true one.") May I add that in my view in some respects it is an exceedingly unpatriotic paper. I do not think it is right, when tramway undertakings consent to delay ordinary reconstruction, to say it is a mistaken policy and simply laying up extra work for times to come. My view is at the present juncture that all reconstruction work upon lines, and other work which is not absolutely necessary, should be delayed. I am sure that my professional brethren will be willing to strain every nerve to lay aside expenditure on permanent way and in other directions, so that the money and labour may go to help the country to win this great fight. That was a phrase in Mr. Baker's communication of which I took particular notice, and it seemed to me to be quite contrary to what I conceive to be my duty, and to what I think most tramway men conceive to be their duty. So much has been said with regard to fares and the policy of changing fares at this time, that I do not think there is anything to be added. In setting out the fares for a system a safe margin should be provided, so that we can continue without increasing fares. It would require a deliberate certainty to induce people, without strong protests, to pay more for tramway travelling than they can get at the old price, at any rate in Leeds. We have not increased fares, and yet our revenue, with the old fares throughout the war, shows about the same percentage of increase as there is in Birmingham. If one can serve the public and maintain the financial position without increasing fares, I am sure that my friend Mr. Baker, and those who have spoken in support of his views, would not think it necessary or right that fares should be increased. I confess I have some difficulty in following the figures. I should like very much to know something about Mr. Baker's figures for June, 1915, and August, 1915. In this room where I have heard Mr. Baker so frequently give evidence—a room sacred to arbitrations—we have from time to time accepted even on the buyer's side that a penny per car-mile is sufficient and reasonable depreciation. The last figures for 1915, June and August, give us 1·49d. per car-mile, or equal to 1½d. as increase of revenue, which brings in £1,666. If you take the increase in that way it means £20,000 a year. (Mr. Baker: "No, it is a week.") I see, that meets the point I could not follow. It is a great pity Mr. Baker, having given his increase in revenue per mile and per week did not give us comparable figures of increased cost at per mile and per week.

In any case, gentlemen, I do not think it should go forth that in the view of the Tramways Association the municipalities should endeavour, whether they need the money or not, to help themselves just because the money is about. We have had from the very highest quarter in the land advice as regards thrift and expenditure, and we ought to organise our undertakings carefully and manage them with the utmost economy, and so endeavour to carry the people at the very lowest price we possibly can. That is the moral of it, and it has been almost invariably recognised throughout the country. Birmingham is the only case I know of so far in which fares have been raised, and it has not been proved by any fact adduced that it was necessary to take this extreme step.

Mr. W. T. ROBSON (general manager, Southampton Corporation Tramways).—There is one point I should like to put before Mr. Baker. He has proved his case that his increase is due to raising the fares, but I should like to ask if this is not an inflated increase due to the high wages the people get in Birmingham at the present time. It appears to me that as soon as the people begin to feel the pinch and begin to feel the effect of the new Budget, they will begin to economise in fares, and then it may be that Mr. Baker will have to put his fares down again in order to induce people to ride.

Councillor BISHOP (vice-chairman, Walthamstow Tramways Committee).—I have listened to Mr. Baker's paper with great interest, and I am sure the various representatives from my area have also heard it with a great deal of pleasure. It is very interesting from our point of view to hear you talk about surplus profits relieving rates and building up your depreciation funds, but I have not heard a word as to what you are to do when you have not any surplus profits. (Laughter.) I agree with Mr. Hamilton in almost everything he said. I do not think it should go forth from this conference that the tramway authorities are after people's money because they can get it. To put fares up at a time like this without hearing a single grumble from passengers sounds like a fairy story. I am afraid that we could not put fares up without great trouble and much grumbling. A point I should like to draw Mr. Baker's attention to is this; he informs us that by putting fares up he has got an increase in receipts of £1,666 per week, and that it is greatly due, from his own words, to the fact that money is pretty plentiful in Birmingham at present owing to the district being a munitions area. If I were Mr. Baker I should not make that fact quite so public, because I believe Mr. McKenna in his wisdom has decided to take 50 per cent. of abnormal war profits, and if that is not an abnormal war profit I do not know what is. If it is due to the prosperity of the people in a munition area it must be due to the war, and I am afraid that the income tax on the Birmingham tramways will be larger even than Mr. Baker anticipates at the present moment. I do think the paper strikes a pessimistic note; I do not think we need be pessimistic in any way. A previous speaker has referred to the 1870 war. I remember the time well. Undoubtedly there was a large influx of trade in this country. I am certain that when the war is over there will not be such a slump as many of our pessimistic friends predict. My last point is that money will not be quite so scarce as some municipal authorities imagine it will be. Many people think money will be difficult to obtain, but I am looking forward to the time when Germany and Austria will be paying a large war indemnity.

Councillor W. J. T. CULLIS (chairman, Ilford Tramways Committee).—May I as a layman tender my thanks to Mr. Baker for his paper? As a paean of praise it was perfect. Had he been in a pulpit I should have recognised his text immediately as "Make hay while the sun shines." Mr. Baker has given us an admirable view of the possibilities of Birmingham from a tramway point of view. He has told us that they have increased their fares from 1½d. to 2d. and from 2d. to 2½d., and they have reduced the distance, I understand, in the penny stage. Mr. Baker is a Birmingham man, and he is dealing with the possibilities of Birmingham; but the possibilities that he has dealt with to-day are not in any way applicable to us poor suburbanites in our tramway undertakings. Unfortunately, although I thank Mr. Baker for all the information he has given me, I have failed to glean the possibility of a similar course being applied to our own small undertakings. Again, Mr. Baker

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is dealing with Birmingham. At the present moment Birmingham is a gold mine. That does not apply in a small area. Our area at Ilford is untouched by munition work. We have very little justification or very little reason that would enable us to raise fares. Unfortunately we have ½d. fares, and it would be extremely difficult to deal with them unless we abolished them, and to abolish them would mean revolution. We are tied there, and Mr. Baker's paper, although dealing with a great improvement applicable to large areas, does not apply to us. With regard to the ratepayers' position in connection with the tramways, I thoroughly endorse the expression of opinion of one of the speakers that a tramways undertaking is the ratepayers' property, and that a certain percentage if possible of the accumulated profits should revert to the owners of the tramways. With regard to the depreciation fund, I am thoroughly in accord with creating a safe position. I think the only safe position is to have a fund to meet all the necessities, and then give all the profits to the ratepayers.

Alderman FLINT (chairman, Leicester Tramways Committee). – I should like to say a word of thanks to Mr. Baker, for we have a good deal to learn from this discussion. But if a text is to be given to Mr. Baker's paper I think you might very well take "Looking ahead." I desire to address myself to that point, for I think that is the position which it is the duty of all present to take up. It has been stated by a previous speaker in regard to the question of rates that there is a great deal of grumbling. Surely we have got beyond that; I was under the impression that every Tramways Committee had to face a certain amount of grumbling. I live in a town where we have as much grumbling as there is in any other town, but I do not think we should be wise to take too much notice of that. It seems to me that Mr. Baker has really given us the cue to our policy—is it better to go through the coming year and be met with a deficit, or is it better to look ahead and take such action as will prevent a deficit? I happen to be chairman of the Leicester Tramways Committee, and I have had to look at the financial position very seriously. We are doing very well at present; I do not know that I need hesitate to say so. In Leicester we are doing better than some other Midland towns, and even some of the northern towns. Our receipts are going up, but we want to make a very great distinction between receipts and profits. Although our receipts are better than they were last year, any comparisons of 1915 with 1914 are fallacious and not to be depended upon. But receipts and expenditure for 1913-1914 might be compared with what will probably take place during the year just commenced. I take it that in every town it costs more for operating expenses, it costs more for current, costs more for income-tax, more for local as well as Imperial taxes, and, in addition, although we are working with less men our expenses are very greatly, or at least considerably higher. That statement when made in Leicester is not swallowed very readily, but it is true, because although we are working with less men we are training a lot of other men. I suppose soon we shall probably have to train women, and that is a large expense. There is also the loss of conductors missing fares, and of new motormen not working their controllers properly. So in every aspect our expenditure is higher than it was two years ago, and we came to the conclusion after carefully considering the matter that we wanted at least £40,000 or £45,000 more to meet the new expenses of the coming year. The question is where is that money to come from? We have got to get it or else be landed in a worse position than we are in to-day. We decided to keep on the safe side, and to follow the example of Birmingham. I think those who do not do that now will regret it in twelve months' time. Though they have a little increase in receipts, those other towns will find that the expenses are very much higher, and that the increased receipts will not help to balance out at all. I do contend that it is very much better to look ahead and take such action as will prevent a deficit, and not simply go forward hoping for the best but finding things turn out for the worse. In view of the financial reports which have been published, I am certain that if a number of towns do not take action now of some kind in order to increase profits as well as receipts or income, they will be on the wrong side of the hedge at the end of a year's experience. I think it is much better to keep up the reputation our tramways have obtained for sound finance, and that it will also be much better to take action at the present time.

Mr. W. MURRAY (manager, Walthamstow Council Tramways).—To my mind this question is one more for Tramway Committees of the Town Councils than for us tramway managers. A manager's duty is to advise his Council, but the Council does not always accept his advice; therefore he ought not to be required to take the responsibility for the policy adopted. There are two schools of thought prevailing in some Councils, one school believes that the tramways ought to be run like all other commercial businesses, be made to meet its own responsibilities, pay its way, and, if possible, leave a margin of profit. Another school of thought believes that, given very cheap fares, a very frequent service, the development of the town, the introduction of large public works, increased demands for electricity as a motive power, and general progress of the town, it does not matter much whether the financial result of the tramways undertaking is a profit or a loss. I say the whole matter depends upon the policy the Council decide to follow, and the tramways manager should not be held responsible for the financial result. I do not say which of these policies is right. Of course, no tramway manager likes to run a business that does not pay. It does not improve his credit, and it does not help his salary; but the responsibility for the success or non-success of the finances of the undertaking does not always rest with the tramways manager. There is one way in which economy can be exercised which has not been mentioned this afternoon, and which to say the least is of importance, i.e., a reduction of expense by doing away with unnecessary car mileage. If we widen out the car services, say, from three to five minutes, and five to ten minutes, and if we had no opposition, then no doubt we could make the tramways pay and pay well. Circumstances, however, are such in London at present that it cannot be done. We give exceptionally cheap fares, we carry thousands of workpeople daily at a dead loss, up to 8 a.m. These are matters of policy, and for these things the Councils alone are responsible. But if they decide that the tramways must be made to pay, that could easily be done, provided we had no competition. Better times may come if the competing parties will join hands and decide that we will not run an unprofitable service. I was glad to hear the remarks generally of Sir John Courtis, and I hope that the Councils will realise that the responsibility for the policy on which their tramways are run rests with them and not with the managers.

Mr. H. E. BLAIN, a visitor and past president, was invited to speak by the President. He said: I do not think I should have ventured to take part in this discussion but for the courteous invitation extended to me from the chair. I should like in the few words I have to say to make personal reference rather than any reference to the admirable paper Mr. Baker has given us. I would like to thank the Executive, through the hon. secretary, for so kindly inviting me here to-day. Although perhaps, in one sense, I may be engaged in a different aspect of traction work to that in which I was interested before, I do not think that any of you will believe that I have any other than the warmest recollections of my association with this organisation, and the very keenest of friendship with so many of the people I see around me. I do not want to say more than one other thing, and that is I do not think anybody can look at what has been done in connection with traction undertakings in this country during the past year without a feeling of pride from many aspects, pride in the patriotism of those undertakings, the response that those undertakings have given in the personnel that they have sent to H.M. Forces both on land and sea, patriotism in the making of munitions, and patriotism in devoting their every energy to serve their country's cause in whatever manner they can do it. That may be said without fear of contradiction, and it is something of which I feel very deeply proud. I thank you for the opportunity of being present and of saying a few words to my old friends. (Applause.)

Mr. A. BAKER, replying to the discussion, said.—I have very little to say. There is one thing I should like to make quite clear, and it is this -I have not come here to suggest to you gentlemen that it is your business to go home and immediately raise your fares. One or two speakers have deprecated the idea that it should go out from this conference that you should do as Birmingham has done. I do not make any such suggestion; all I have to say is that in Birmingham we were faced with a financial problem. I have told you how we have met it. There has been no grumbling or dissension in Birmingham on account of increased fares. As I have said, as sensible people the public expected the tramway fares would go up like other things. I think I tried to make it clear in my paper that fares were fixed in the early stages of municipal tramway operation when wages were probably 30 per cent. or 40 per cent. less than they are now. Therefore, unless you have been charging considerably more all these years than you ought to have charged, how you are going to live now I do not know, having regard to the tremendously increased cost of production. In other words, if you are selling an article at 9d. which cost in production 9d., where are you going to? You have got to go on the rates. The question is whether it is better for passengers to pay a little more for their rides or for the Tramways Committee to go to the Corporation and say we want £5,000 or £6,000 to cover the loss sustained during the last financial year. I do not say that the situation in Birmingham is applicable in every other place. I know it is not. You have got to deal with this matter as you think best according to local circumstances. Mr. Robson asks if we shall reduce our fares after the war. I do not know whether we shall or whether we shall not. We shall deal with the situation when it arises. I rather gave offence to somebody by saying we have to get the money while it is about, and I was accused of unpatriotic conduct. I believe Mr. Hamilton suggests I am the most unpatriotic person in the world because I will not put off reconstruction of tramways which are absolutely worn out. All I can say to Mr. Hamilton and others is that if I do not repair the tramways we have got to stop running. They have got into a bad condition, and I say further, if I do delay the evil day, I am mounting up a score of responsibilities that will be very difficult to wipe off in future years. I thank you for the courteous manner in which you have received the paper. As I said, it is merely a statement of how we have met the situation in Birmingham; at the moment it looks highly successful. Whether it will continue so remains to be seen. We hope for the best. (Applause.)

A formal vote of thanks to Mr. Baker and his acknowledgment closed the conference.

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FRIDAY'S PROCEEDINGS.

MANAGERS' SECTION.

A meeting of the Managers' Section of the Association was held on Friday morning, Alderman H. Linsley, J.P., presiding. A resolution was passed similar in terms to one adopted last year, leaving the question of holding a meeting of managers during the ensuing 12 months in the hands of the Executive Council.

Before closing the meeting the President alluded to the recent death of Mr. John Gardner, manager of the Chester Corporation Tramways, of which they had all learned with deep regret. When they were at Chester Mr. Gardner had entertained them most hospitably in a way which they would always remember. He proposed that they should send a letter of condolence to his family expressing their esteem and regret.

This was agreed to by the members upstanding in silence.

ANNUAL BUSINESS MEETING.

The annual business meeting of the Association was afterwards held, Alderman H. Linsley, J.P., presiding, supported by Messrs. Fearnley, Clough, Mozley, Fisher, Holford, Miles, Flint, C. F. Spencer, Goodyer, Baker, Fell, Dalrymple, McElroy, Hamilton, James (hon. solicitor), and the hon. secretary, members of the Executive Council.

The Secretary read the notice convening the meeting, after which the minutes of the previous meeting were duly confirmed.

REPORT OF THE EXECUTIVE COUNCIL.

The annual report of the Executive Council was presented, and on the motion of Mr. Arthur Ellis (city electrical engineer and tramways manager, Cardiff), seconded by Alderman J. Bowes (chairman of Manchester Corporation Tramways Committee), it was unanimously adopted without discussion. [The text of the report is given in following pages.]

ELECTION OF PRESIDENT.

The PRESIDENT.—It falls to my lot to perform a very pleasant duty, and that is to propose to you for your consideration a gentleman for the position of president. It is generally understood, I think, in this meeting who that person is, namely, our friend Mr. Peter Fisher, of Dundee. (Loud applause.) Mr. Fisher has had a very long experience in tramway matters, and that experience will serve him well in the chair. I am afraid I felt the lack of that experience as my weakness, namely, not being acquainted with technical matters. Such a lack of knowledge is some drawback to a layman holding the position of president. I must thank you for your indulgence in any shortcomings I have shown. I feel certain that with Mr. Fisher in the chair this Association will be presided over in a very efficient manner. It is with the greatest possible pleasure therefore that I move that Mr. Fisher, of Dundee, be the President for next year. (Applause.)

Mr. J. B. HAMILTON (general manager, Leeds City Tramways).—I had very great pleasure two years ago at Sheffield in proposing Mr. Fisher for the position of vice-president, and it is proposed, not unappropriately, that to-day I may be allowed the privilege of seconding his nomination as president. Mr. Fisher, along with three others and myself, are now the only original members of the Association. I remember the meeting at Manchester when we met Mr. McElroy as secretary. Mr. Fisher has been a loyal and consistent attender at our meetings and a helpful member of committees, and that he should only now be going forward for the position of president is due to that retiring character which is a part of Mr. Fisher's nature. That Mr. Fisher should come from north of the Tweed is nothing against him I am sure.

Alderman J. BOWES.—It accounts for his modesty. (Laughter.)

Mr. J. B. HAMILTON.—I feel sure Mr. Fisher's qualifications for the post are so well known to the members that it is quite unnecessary that I should detain you longer, and therefore I simply second his nomination.

The motion was carried unanimously amid applause.

The PRESIDENT (addressing Mr. Fisher).—Mr. Fisher, it must be very gratifying to you that you have been unanimously elected president of this Association, and it now devolves upon me to pass this chain of office from my shoulders to yours. I wish you very good health during the year of office, and I am sure we shall find in you a very excellent president. (Applause.)

Mr. P. FISHER.—I need not say that I feel it is a great honour that you have conferred on me this morning, and with your help during my year of office I will do everything in my power to maintain the dignity and continue the usefulness and influence of this Association. (Hear, hear.) This is not a moment when I can say much with liberty. Too much of the personal element is mixed up with the subject. In future I may have opportunities of giving you my views on matters which concern the Association and its work. In the meantime in one word I thank you. (Applause.)

The PRESIDENT.—It has been suggested to me that the chairman of the Dundee Tramways Committee may wish to say a few words.

Councillor G. A. JOHNSTON (chairman of Dundee Corporation Tramways Committee).—It falls to me to acknowledge the honour conferred on the Dundee Corporation by the election of our esteemed tramway manager to the office of president of this important Association. The Corporation of Dundee will esteem it a privilege to welcome this Association if they see fit to visit us at the next conference. The circumstances at present do not justify us in looking forward with any degree of confidence as to when that may be, and whether a conference will be justified as long as the present war continues remains to be seen. Still, notwithstanding the Scottish characteristic of thrift and canniness, you will find, if you come to us, that we know how to dispense hospitality. (Applause.) This is the third conference I have had the honour of attending, and I have been duly impressed with the business capacity of the gentlemen who take part. If you happen to come to Dundee, as I hope, you will find that though not a very large city we have a due share of the municipal "go" necessary, particularly in the trading departments such as tramways, electricity, gas and water. I think you will find we are pretty well in the front. I have no doubt the Corporation will do all in their power to make the visit pleasant as well as interesting. (Applause.) In the past you have had a line of presidents of a very high order, and I am sure you will find in

Mr. Peter Fisher,
President, Municipal Tramways Association.

Mr. Fisher a worthy successor. You will allow me to extend my congratulations to the President-elect and to wish him every success.

ELECTION OF VICE-PRESIDENT.

Alderman FLINT, J.P. (chairman, Leicester Corporation Tramways Committee), in proposing that Mr. Henry Mozley (general manager, Burnley Corporation Tramways) should be elected vice-president of the Association for the ensuring year, said: Mr. Mozley has from the first—for many years to my own knowledge—taken the greatest interest in the Association and in all work pertaining to it. He is a very capable and intelligent and efficient man and one in whom we have the most perfect confidence and for whom we have very great esteem. (Applause.)

Alderman J. MILES (chairman, Bolton Corporation Tramways Committee).—I have great pleasure in seconding the motion. We all know Mr. Mozley; we esteem him highly. We esteem his breeziness, his knowledge of his work and his determination that he will not let his voice be silent when he thinks it ought to be heard. (Hear, hear.) I predict that in Mr. Mozley we shall have a most excellent vice-president. We hope he will have a very happy year of office. We know he takes a deep interest in his work and in the work of this Association. We shall put the right man in the right

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place by electing him, and on these grounds I have the greatest pleasure in seconding. (Applause.)

Mr. C. J. SPENCER (secretary).—I would like to take the opportunity of supporting the nomination and saying that in Mr. Mozley we have a very old member, who has on more than one occasion stood before this Association and maintained his views with spirit and cogency. On more than one occasion he has ploughed his lonely furrow when he seemed not to have a friend. Yet we have lived sufficiently long to realise that some of the views held alone in the past by Mr. Mozley have proved to be right. Mr. Mozley is eminently fitted for the post and I have great pleasure in supporting the motion. (Hear, hear.)

The motion was unanimously carried.

Mr. HENRY MOZLEY (Burnley).—I have to thank you from the bottom of my heart for the honour you have conferred on me. I recognise that the town I represent occupies a very small place on the map, but I would remind you that it is a town which has pioneered mechanical traction in this country. I believe we were either the second or the third to adopt it. The date of the Act is 1879, and the line was in operation in 1881. The Burnley people will fully appreciate the distinguished honour you have conferred on me, and I shall take care to convey to my chairman the hearty

Mr. Henry Mozley,
Vice-President, Municipal Tramways Association.

way in which the resolution has been carried. I can assure you that during my year of office I shall do my duty as I have tried to do it in the past. (Applause.)

ELECTION OF MEMBERS OF THE EXECUTIVE COUNCIL.

The PRESIDENT.—The next business is the election of members to the Executive Council. There are certain members retiring this year and it is for you to nominate anyone you think proper.

Mr. C. J. SPENCER (hon. secretary).—The following retire from the Executive Council and are eligible for re-election. The committee representative who retires is Alderman Miles and the managerial representatives who retire are Messrs. Hamilton, Holford, and Fell. There is an additional vacancy due to Mr. Mozley now stepping up to the position of vice-president, so that there is room on the Executive for a new man.

Nominations were then called for, and there were proposed: Alderman H. W. Littler (chairman, West Ham Tramways Committee), Mr. G. W. Holford (Salford), Mr. J. B. Hamilton (Leeds), Mr. A. L. C. Fell (London), Mr. W. J. McCombe (Hull), and Alderman J. Miles (chairman, Bolton Corporation Tramways Committee). Messrs. Alderman J. Bowes (Manchester) and Alderman H. Brown (Leeds) were appointed scrutineers. It was eventually announced that Messrs. Holford, Hamilton, Fell, Miles, and Littler had been elected.

On the motion of Mr. J. B. Hamilton, seconded by Alderman F. Smith (vice-chairman, Liverpool Tramways Committee), Mr. E. R. Pickmere, town clerk, Liverpool, and Mr. S. F. James, town clerk, Ilkeston, were re-elected honorary solicitors to the Association.

MR. C. J. SPENCER RE-ELECTED HON. SECRETARY.

The PRESIDENT.—The next business is the appointment of hon. secretary and treasurer. I should be very pleased if some gentleman will make a proposal.

Alderman J. MILES.—I had the privilege once of moving that Mr. C. J. Spencer should be asked to occupy this position, and I went somewhat fully into the merits of the gentleman that we all esteem and love so much. (Hear, hear.) I am in such a position this morning that I could, if necessary, enlarge on that, but it is not necessary, because we all know that Mr. Spencer is absolutely *au fait* with the work, and has his whole heart in doing everything he possibly can for the interests of this Association. (Hear, hear.) Apart from all that, his geniality makes him, as I say, loved by everyone, and I hope the day is far distant when we shall lose the services of Mr. Spencer as Secretary of the Association. I believe he loves the work and is very pleased indeed to meet us from time to time, and I cannot help expressing my own feeling as to the way in which the work is done. It is anything but slipshod; everything is perfectly straight and perfectly understandable. I do ask that Mr. Spencer, as he right worthily deserves it, shall receive the whole-hearted support of the Association. I move with the greatest pleasure that he be reappointed honorary secretary and treasurer.

Mr. JOHN ALDWORTH (general manager, Nottingham Corporation Tramways).—I have pleasure in seconding the motion. Mr. Spencer has filled the office of vice-president and president with great honour to himself and great advantage to the Association. I am sure we could not possibly have the position of secretary and treasurer better filled.

The PRESIDENT.—I should like to support the resolution. I have known Mr. Spencer for two years very closely. I know the great assistance he has been to me and to the Association, and I have the greatest pleasure in supporting what has been said about his abilities and the way in which he has conducted the business.

The motion was unanimously agreed to.

Mr. SPENCER.—It is very gratifying to me to hear these very nice things, and I shall be very glad to serve you to the best of my ability for one more year. (Applause.)

HONORARY AUDITOR.

The PRESIDENT.—The next and last business on the agenda is the appointment of auditor. Mr. McCombe has been auditor in the past.

On the motion of Mr. A. Baker (Birmingham), Mr. W. J. McCombe was unanimously re-appointed auditor.

VOTES OF THANKS.

Bailie ALSTON (Glasgow).—As this is the end of the proceedings, I think there is one duty which this conference has to perform now which will be very pleasant, and it has fallen to me to propose a motion. I feel honoured at being allowed to propose it, and it is in these terms: "That the best thanks of the conference be given to our chairman, Alderman Linsley, for his services during the past two years." I need hardly say anything in support of this resolution. Alderman Linsley has been president over a most trying period in the history of this Association. All of us who have been under his chairmanship must have admired the cool, deliberate manner in which he has given his rulings and conducted the business. I wish that statesmen and others responsible in high authority would copy the evident desire of Alderman Linsley to be fair and to be right in all their doings. Alderman Linsley has taken time so as exactly to know where he was, and that is a virtue which I hope gentlemen in positions of trust and authority will always copy. We are deeply indebted to him for the way in which he has conducted the business of this conference and for his services during the past two years. (Applause.)

Alderman FLINT.—I have pleasure in seconding that motion, and I associate myself with all that the mover has said with all my heart. (Applause.)

The motion was carried with acclamation.

The PRESIDENT.—The mover of this resolution has mentioned what he says are the virtues which I possess, but I am afraid he has been blind to my shortcomings. I have had a good many shortcomings during my term of office, but I have been assisted by the Executive and especially by our secretary, and at meetings of this kind by members generally, for which I beg to thank them very heartily indeed. I have enjoyed the position very much and I have felt it a great honour to hold it. My Corporation and the Tramways Committee have appreciated the fact that I have been president for two years of this very large Association. My experience enables me to say that this Association is a live one. It is alive to all that interests the tramway world generally, and I feel sure that under the new presidency we shall be as successful in the coming year as in the past. My only disappointment is that we are not living in normal times, and that I have not had the pleasure of seeing you in Salford as I should like to have done. I thank you very much indeed. (Applause.)

Alderman H. W. LITTLER.—I have a very pleasant duty, but at the same time a difficult one. It is to propose a vote of thanks to

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our worthy secretary. The difficulty is created by the admirable expression of high appreciation which has already been given. It fails me to find words more suitable, and I can only re-echo those words of recommendation which were uttered when Mr. Spencer was asked to continue to be the secretary of the Association. During the past year he has missed many burdens, such as the troubles to find hotel accommodation for us; he has missed the burden of making arrangements for outings and things of that kind, but we remember the admirable arrangements he made in normal years for our accommodation and comfort and pleasure. This year, owing to the changed circumstances of the country, he has been deprived of those duties, and I know how well he enjoyed performing them in the past. I cannot speak of his work on the Executive Council, but I believe the seconder of this resolution will be able to explain to you how valuable his services there are. We recognise in Mr. Spencer a very pleasant, willing helper, and one who has evidently very sincerely the interests of this Association at heart, and who is most industrious in the performance of every duty devolving on him. It would be unbecoming in us if we did not award him a very hearty vote of thanks. I have the greatest pleasure in moving the hearty thanks of this conference and of the Association to Mr. Spencer for the admirable way in which he has carried out the duties during the past year. (Applause.)

Mr. A. R. Fearnley (general manager, Sheffield Corporation Tramways).—I have much pleasure in seconding the resolution. Being Mr. Spencer's immediate predecessor in the position of Secretary, I know the demands made on a man's personal time, as well as on his business time. I say unhesitatingly that we are all indebted to Mr. Spencer and also to his Corporation for allowing him to carry on the duties of his position as secretary. I do not know whether I am giving away a secret if I say that this is probably Mr. Spencer's last year of office. There is a tacit understanding that when a man accepts the position of honorary secretary he takes it for five years, and he has also put on him the onus of suggesting his successor. So you see the duties are onerous all the way through. Mr. Spencer has been associated with me in tramway work for 20 years, and that association has always been of the happiest. I have much pleasure in commending this resolution to your notice. (Applause.)

The motion was carried unanimously.

Mr. C. J. Spencer.—This is the second time on which I have had to reply to something in the nature of a vote of thanks to-day. I am extremely obliged to you for your many kind sentiments and for the remarks of Alderman Littler whom I, as secretary, heartily welcome on the Executive Committee. A number of the virtues which you ascribe to me in connection with the office of secretary are really the virtues of other people. Before I took this position two very able gentlemen held it in succession, and it has been my easy duty to follow in their footsteps. I have been also greatly helped by my able assistant, Mr. Falkingham, and I take this opportunity of recognising it. Further, the admirable attitude of the members of the Executive helps the secretary. Moreover, the kindly feeling that I hope exists between myself and every member of the Association will always tend to smooth working. Therefore I think if any honour is due, it is due to all of us. (Applause.)

The proceedings then terminated.

ANNUAL REPORT OF THE EXECUTIVE COUNCIL.

The report of the Executive Council on the work for the past year was as follows:—

Annual Conference.

The Council fully considered the question of holding the Annual Conference, which in the ordinary course of events would have been held in Salford this year, and after consulting by correspondence the members of the Association came to the conclusion, having regard to the European crisis, that it was not desirable to follow the usual practice. On the other hand, it was felt that there were some tramway questions in connection with the war which could be discussed with advantage, and it was therefore decided to have a one day's conference in London in addition to the ordinary business meeting, which is necessary under the Articles of Association. It was further decided that no social functions of any kind should take place, and that the attendance at the meetings be restricted to the members of the Association.

New Members and Resignations.

The following have joined the Association during the year:—

Local Authorities—Colne Corporation.

Managers and Assistants—

A. J. Abraham, general manager and engineer, Aberdare Urban District Council.

T. G. Richardson, general manager, Corporation Tramways, Colne.

J. C. Williams, general manager, Erith Urban District Council.

J. F. Cameron, general manager, Corporation Tramways, Northampton.

J. C. Whiteley, general manager, Corporation Tramways, South Shields.

J. W. Blakeborough, Accountant, Corporation Tramways, Leeds.

The following have resigned their membership during the year:—

A. Coveney, electrical engineer and tramways manager, Erith Urban District Council.

H. E. Yerbury, chief electrical engineer, Corporation Tramways, Sheffield.

J. Gottschalk, general manager, Corporation Tramways, Northampton.

L. Johnston, general manager, Corporation Tramways, Southampton.

T. J. Hutton, accountant, Corporation Tramways, Leeds.

The Council regret to announce the death of Mr. R. W. Smith-Saville, A.M.Inst.C.E., borough engineer and tramways engineer, Darwen, who has been a member of the Association for many years.

Appended is a comparative summary of the members for the past four years.

	1911-12.	1912-13.	1913-14.	1914-15.
Honorary Members ...	1	1	1	1
Local Authorities ...	72	75	75	76
Managers and Assistants	105	109	111	111

Meetings of Executive Council, Etc.

Since the publication of the last annual report the Council have held seven meetings, two of these having been held at Salford, and the remainder at Leeds, London, Bradford, Birmingham, and Manchester respectively. There has also been a number of meetings of the special committees and sub-committees, appointed to deal with specific matters. These committees have reported to the Council periodically upon matters referred to them.

Development of the Electric Vehicle.

The Executive Council have been approached by the Electric Vehicle Committee, which has been founded under the auspices of the Incorporated Municipal Electrical Association, and which is affiliated with the Electric Vehicle Association of America, to co-operate with them by nominating a representative to sit upon the committee, whose main object is to encourage the development of the electric vehicle.

The Council thought it desirable that they should be represented, and appointed Mr. A. R. Fearnley (Past President), general manager of the Sheffield Corporation Tramways, as their representative on this committee.

Defects in Tramcar Controllers.

The Joint Committee, comprising Mr. W. Clough (Bury) and Mr. C. J. Spencer (hon. secretary), representing the Municipal Tramways Association, and Messrs. A. L. C. Fell, R. Humphreys, C. W. G. Little, A. H. Pott, and A. de Turckheim (secretary), representing the Tramways and Light Railways Association, completed their investigations of the question of tramcar controllers and their connections so far as they concern magnetic brakes, and submitted a report thereon to the Association.

Mr. A. L. C. Fell, chief officer, London County Council Tramways, has been experimenting with a modified arrangement of the controller connections, with a view to overcoming faults existing on the early Dick-Kerr type of controllers, used on the London County Council Tramways, and the following communication on the subject has been sent to the members as a supplement to the above-mentioned report:—

Defects in Tramcar Controllers.

"With reference to the report of the special Joint Committee of the Municipal Tramways Association (Incorporated) and the Tramways and Light Railways Association, on the subject of defects in tramcar controllers, I beg to report that with a view to overcoming faults existing on the early Dick-Kerr type of controllers used on this system, experiments have been made with a modified arrangement of the controller connections.

As these modifications to a very large extent overcome the faults especially referred to under Group I. of the committee's report, the method adopted may be of interest to your Association.

Fault.

(*a*) The terminal boards are fitted in the lower part of the controller with terminals very close together, making it difficult to avoid overlapping of the cables leading thereto, and thus introducing a potential defect in the form of abrasion of the cable insulation.

Alterations Made.

The terminals on the finger boards have been removed and special terminals fitted to the finger bases.

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(*c*) The cutting out of one motor from any cause whatever, whether voluntary or otherwise, renders the electric brake entirely inoperative.	This fault occurs where the motors are connected in cascade for braking, and are therefore inter-dependent on one another. The controller wiring has been rearranged in such a manner that the motors are connected in parallel and equalised, braking with one motor thereby being rendered possible.
(*d*) Difficulty is experienced in maintaining part of the brake circuit in a state of efficiency, as magnetic braking was not arranged for in the original design, and certain fingers and segments have had to be added for this purpose in spaces not sufficiently large to ensure the best possible insulation.	Ample space for the additional fingers and segments required has been obtained by the removal of the terminals referred to under.

Incidentally, it might be noted that the removal of the terminals eliminates a considerable amount of the controller back wiring and joints, and in addition to the improved braking obtained, a very material reduction in the number of armature and field coil failures is anticipated with the altered controllers.

(Signed) A. L. C. Fell,
Chief officer, London County Council Tramways."

The Board of Trade in acknowledging receipt of the report of the Joint Committee, expressed their thanks to the two Associations for the action which they had taken in this matter. The Council take this opportunity of expressing their gratitude to the members of the Joint Committee, and hope that their combined efforts will have substantial results.

Caledonian Railway Order, 1915—Road Vehicles.

The Caledonian Railway Company sought powers to run omnibuses and road vehicles in accordance with the following clause of the Order :—

Excerpt from Caledonian Railway Provisional Order, 1915.

"(4) 1. The company may provide own use and work in connection with or in extension of their railway system or otherwise in any district to which their said system affords access or in which they may find it expedient to afford improved means of communication omnibuses coaches cars wagons and other road vehicles to be drawn or moved by animal electrical or any mechanical power and may therein convey passengers luggage parcels animals and merchandise whether to and from any of their stations or hotels or otherwise and may make and recover such charges in respect of such conveyance as the Company may from time to time appoint and the company may enter into contracts or agreements with any company or person for or in relation to the supply or working of any such omnibuses coaches cars wagons and other road vehicles.

(2) Any electrical power used shall be entirely contained in and carried along with such road vehicles in such a manner that no magnetic or other influence is created which is likely to affect telegraphic communication by means of any telegraphs of the Postmaster-General."

The Corporations of Glasgow, Dundee, Edinburgh, and Aberdeen petitioned against the Bill, and the Association undertook to give every possible assistance.

Notification was subsequently received that the Caledonian Railway Company had decided not to proceed with the clauses relating to motor road vehicles.

Motor Omnibus Traffic, Road Maintenance, Etc.

The sub-committee appointed to deal with this matter in consultation with the Association's London Agents (Messrs. Dyson and Company), were informed that the terms of reference of the proposed committee, composed of members of both houses, to investigate the question of Motor Omnibus Traffic and Road Maintenance, were as under :—

"That it is desirable that a joint committee of both houses be appointed to inquire into and report as to the present law relating to the running of motor omnibuses and trolley vehicles under statutory powers and otherwise whether any amendment is necessary with respect to the control to be exercised by Local Authorities ; and what contributions, if any, should be payable towards the cost of road maintenance by the proprietors of such vehicles."

The sub-committee decided to communicate with the Association of Municipal Corporations with a view to discussing certain broad principles, and a preliminary conference has taken place between representatives of the two Associations. A report will be submitted later.

Road Damage by Heavy Motor Traction.

In view of the complaints which have been made as to the alleged excessive damage caused to roads by certain classes of heavy motors and locomotives, the President of the Local Government Board (Rt. Hon. H. Samuel) appointed a small Expert Committee to inquire into the sufficiency of the existing requirements with respect to the construction of these vehicles, including weights on wheels, widths of tires, diameters of wheels, etc.

The constitution of the committee and the terms of reference are as under : -

Expert Committee on Road Vehicles.

Mr. E. Shortt, K.C., M.P., chairman.	Mr. E. J. Lovegrove, M.I.C.E.
Mr. A. G. G. Asher, W.S.	Mr. J. E. Thornycroft, A.M.I.C.E.
Mr. P. M. Crossthwaite, M.I.C.E.	Mr. J. Wilmot, F.S.I.
Mr. H. H. Humphreys, A.M.I.C.E.	Mr. R. J. Simpson, Secretary, Local Government Board.

Terms of Reference.

"To consider the law and regulations relating to the construction and use of road locomotives and heavy motor cars in Great Britain and to report what amendments (if any) are desirable."

The hon. secretary obtained an interview with Mr. Simpson, the secretary of the Departmental Expert Committee, with a view to ascertaining whether it was desirable for the Association to give evidence before this committee.

At the interview, Mr. Simpson stated : -

"That the duties of the Expert Committee were clearly defined, namely (a) to take evidence on the question of road damage by heavy motor traction, and (b) any other evidence which may be forthcoming, which would enable the committee to make recommendations as to the design of wheels, speed limits, and other matters affecting this question. That the committee would be prepared to have any relevent evidence on the matter from the Municipal Tramways Association, but he was afraid that if the evidence was merely a repetition of that which they had already received from many sources, to the effect that heavy motor traffic does considerable damage to the roads, it would not assist the committee very materially ; but if the Association could offer any suggestions as to the design of wheels, or roadway construction, which would assist them in coming to a conclusion, they would be very glad to hear them.

That the larger question, as to whether a special contribution should be paid towards road maintenance by heavy motor users was outside the scope of the Expert Committee."

The sub-committee decided, that inasmuch as the Expert Committee was not concerned with the main questions of principle so far as tramways are concerned, it was not advisable to submit evidence.

Maintenance of Bridges.

The following decisions in connection with the maintenance of bridges by a canal company will be of interest to the members :—

Sharpness New Docks and Gloucester and Birmingham Navigation Company *v.* Attorney-General (at the relation of the Corporation of Worcester).

"A Local Act of 1791 requires a canal company to make such bridges over their canal as certain commissioners appointed for the purpose shall judge proper, and to support, maintain, and keep them in sufficient repair. Bridges were built sufficient for the ordinary traffic of the district of that date, but had now been found to be insufficient to bear the heavy locomotive traffic of the district at the present day."

In the Court of Appeal, in January, 1914, before Vaughan Williams, Swifen Eady, and Kennedy, L.J.J., the decision of Mr. Justice Phillimore (1913), 1 K.B. 422 ; 11 L.G.R. 157 ; 82 L.J.K.B. 187, on this point was reversed, and it was

"Held that a Local Act which provided that all bridges required to carry a highway over a canal should from time to time be supported, maintained, and kept in sufficient repair by the canal company or their successors, created an obligation to maintain and keep in repair such bridges according to the standard of the traffic requirements of the present day."

On appeal to the House of Lords, in February, 1915 (Viscount Haldane, L.C., Lord Dunedin, Lord Atkinson, Lord Parker of Waddington, and Lord Parmoor), the decision of the Court of Appeal was reversed, and it was

"Held, that the defendants were not under an obligation to keep the bridges in repair according to the standard of the traffic requirements of the present day, but were only liable in each case to keep in repair the particular bridge, the size and strength of which were originally determined by the commissioners appointed by the Act."

Income Tax- Assessment of Motor Omnibuses.

The Income Tax Sub-committee have had under consideration the question of the proper allowances for depreciation of motor omnibuses. It was felt both in the interests of the Board of Inland

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Revenue and the Associations concerned, that a uniform method of determining depreciation allowances for income tax purposes to govern the practice for the future should be arrived at, as in the case of tramways. Inquiries showed that the practice throughout the country was very diverse, and that no standard system had been adopted.

This question was first raised in connection with the Manchester Corporation tramways undertaking.

The sub-committee commenced negotiations by conferring with representatives of the Institute of Municipal Treasurers and Accountants, and subsequently with the Tramways and Light Railways Association.

A special committee, comprising two members from each of the undermentioned institutions, was appointed to investigate this matter:—The Municipal Tramways Association (Inc.); The Institute of Municipal Treasurers and Accountants (Inc.); The Metropolitan Omnibus Users' Federation; The Provincial Omnibus Association (Inc.); The Tramways and Light Railways Association.

Mr. J. M. McElroy (Manchester), and Mr. C. J. Spencer (hon. secretary), were appointed to represent the Municipal Tramways Association.

Detailed information has been obtained from the various tramway undertakings, both municipal and company controlled, as to the practice throughout the country, and at a conference of the Joint Committee certain recommendations were adopted which will be placed before the Inland Revenue authorities in due course.

European War.—Enlistments for Military and Munition Service.

On the declaration of war, tramway undertakings throughout the country were very seriously affected, largely due to the fact that many systems employed a considerable number of reservists. In the case of municipalities, inducements in the form of generous allowances to dependents were made to men in their employ to join the forces.

At the time of writing, 16,630 men, or 30 per cent. of the employees on municipal tramway undertakings, have joined His Majesty's Forces.

It will therefore be appreciated that a serious drain has taken place upon the tramway staffs, and the men who have left have not been easily replaced. As a matter of fact, on some undertakings female conductors have been largely employed. In addition to enlistments, a further drain has taken place in the ranks of skilled artisans engaged upon the repair of tramcar equipments, and it was deemed necessary to draw the attention of the Minister of Munitions to the fact, that the efficiency of tramway undertakings was being seriously affected, and point out that it was necessary for a certain number of specially skilled men to be retained if the tramways of the country were to be kept in a safe and efficient running condition.

In the correspondence which took place between the Municipal Tramways Association and the Minister of Munitions (copy of which correspondence has been circulated amongst the members of the Association), it was pointed out that the Municipal Tramways Association were not seeking to further their own interests as tramway operators, but that in many towns munitions were being manufactured and any interference with the tramway service would have a very serious reactionary effect upon the output.

With this point of view the Minister of Munitions agreed, and, as stated in his last letter, he is considering, in consultation with the War Office, whether it is possible to protect tramways against the loss of any of the irreducible minimum of skilled workmen required for the proper working of the tramway service, by means of the issue of badges under Section 8 of the Munitions of War Act, 1915. The Minister states that he is addressing a further communication upon this matter, as it appears somewhat doubtful whether work in connection with tramways can be strictly regarded as being work for war purposes, within the meaning of the section of the Act above referred to.

Allowances to Dependents of Reservists, Etc.

The question of classification in the accounts of the allowances to dependents of men serving with His Majesty's Forces, has had the consideration of the Council, and after discussing the matter with representatives of the Institute of Municipal Treasurers and Accountants, it has been decided that these charges shall appear in the revenue account, but as a separate account of expense, after the total of the working expenses has been arrived at.

Wages and War Bonus.

Soon after the outbreak of war, applications for advances of wages to tramway employees were received by nearly every undertaking in the country, and communications were addressed to the hon. secretary on the matter, and ultimately brought before the Executive Council, who passed the following resolution:—

> "That the secretary be instructed to inform the members that the question of wages of tramway employees during the war had been considered by the Executive Council, and it was felt that whilst it is not in accordance with precedent for the Association to express any opinion on questions of wages and conditions of service of tramway employees, they realised that circumstances at present existing were absolutely without precedent, and expressed the view that the circumstances were such that logically the question was one which affected every employee of each individual Corporation, and was therefore a matter for consideration by the respective Corporations as a whole and not departmentally."

Many local authorities decided to grant a war bonus to their employees, and the classification of these amounts has been the subject of negotiations with representatives of the Institute of Municipal Treasurers and Accountants. It has been agreed that the charges for war bonus shall be treated in the same manner as wages, and charged against that heading in the revenue account.

Interest on Bank Balances.

The question of interest on bank balances was brought before the Executive Council by the Lancashire and Cheshire Tramway Managers' Association.

It was pointed out that whilst the general practice seemed to be for tramway undertakings to have the full benefit of the interest on bank balances, in some towns the Corporation, or the Borough Fund, was credited with this interest as an off-set against an overdraft, and in consequence the tramways department suffered.

Appended is copy of a letter addressed to the Institute of Municipal Treasurers and Accountants, together with copy of their reply:—

"7, Hall Ings, Bradford,
June 3, 1915.

Dear Sir,

Interest on Bank Balances.

At a meeting of my Executive Council held recently, one of the members brought forward the question of interest on tramway bank balances.

It was pointed out that the practice of a good many Corporations is to pool the banking accounts of various departments, with the result that the tramways department, which, in most cases, has a credit balance at the bank, does not receive any interest on bank balances, this being absorbed by the General Fund for the general welfare of the town.

It is considered by some members that this is a very unfair proceeding, and militates against the tramways department, and I was instructed to communicate with you and ascertain the views of your Council on this matter.

I was also requested to communicate with the various tramway undertakings, who are members of the Association, in order to ascertain their practice, but before doing so, I should be very glad to have the opinion of your Institute thereon.

Yours faithfully,
(Signed) C. J. Spencer,
Hon. Secretary.

H. J. Hoare, Esq.,
Hon. Secretary, I.M.T. & A."

"The Old Guildhall, Plymouth,
June 24, 1915.

C. J. Spencer, Esq.,
Hall Ings, Bradford.

Dear Sir,

Interest on Bank Balances.

Adverting to your letter of the 3rd instant, I am desired to acquaint you that in the opinion of the Executive Council of my Institute, each account should be debited or credited with interest on the balances.

Yours faithfully,
H. J. Hoare,
Hon. Secretary.

The Council approved of this decision and the members of the Association have been notified accordingly.

Standardisation of Tramway Rails.

The constitution of the sub-committee of the Engineering Standards Committee on Tramway Rails, is as under:—

*A. Ross, Esq. (chairman).
W. Harper, Esq., Charles F. Wike, Esq., *R. J. Elford, Esq., nominated by the Institution of Municipal and County Engineers.
R. J. Howley, Esq., Dr. F. H. Parshall, *Stephen Sellon, Esq., nominated by the Tramways and Light Railways Association.
*J. B. Hamilton, Esq., J. M. McElroy, Esq., C. J. Spencer, Esq., nominated by the Municipal Tramways Association (Incorporated).
Fred Bland, Esq., Edgar Allen & Company, Limited.
*P. B. Brown, Esq., Hadfield's Steel Foundry Company, Limited.
Percy S. J. Cooper, Esq., North Eastern Steel Company, Limited.
W. Howard-Smith, Esq.
*A. S. Keith, Esq., Walter Scott, Limited.
Geo. Ritchie, Esq., Bolckow, Vaughan and Company, Limited.

* Members of Panel on Tramway Rails.

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The sub-committee has had under consideration (1) the revision of the standard tramway rail sections, (2) the revision of the standard specification for tramway rails, and (3) a report on British standard special trackwork for tramways.

As regards the revision of the standard sections, the sub-committee propose to recommend that the existing standard sections be replaced by three sections, with their corresponding curved sections, having a uniform width of head of 2⅛ in. They also propose to recommend the adoption of a dwarf rail for inter-urban tramways. This rail is primarily intended for use with sleeper construction, has a 2⅛ in. width of head and weighs about 88 lb. per yard. A Panel Committee has been at work preparing recommendations for the revised analysis and mechanical tests for tramway rails. They have presented their report to the sub-committee and the revision of the standard specification is being proceeded with.

A report has been prepared on British standard special trackwork for tramways, dealing with the standard nomenclature of the different classes of special trackwork used in actual practice, and standard dimensions for crossings, switches, and turn-outs.

This report is ready for presentation to the Sectional Committee on Rails.

Tramcar Tires, Axles, and Springs.

The sub-committee of the Engineering Standards Committee on Tramcar Tires, Axles, and Springs is constituted as under :—

*G. J. Churchward, Esq. (chairman).

H. C. Arbuthnot, Esq.	*Albert Good, Esq.
*W. J. Armitage, Esq.	C. M. Hay, Esq.
*D. Bain, Esq.	Ashton M. Heath, Esq.
Lincoln Chandler, Esq.	Cyril Hitchcock, Esq.
*A. E. Collins, Esq.	*R. J. Howley, Esq.
F. C. Fairholme, Esq.	*H. J. Skelton, Esq.
*A. R. Fearnley, Esq.	Henry Steel, jun., Esq.
*A. L. C. Fell, Esq.	,, Dr. W. C. Unwin.

* Members of Panel Committee.

The Panel Committee on Tramway Tires and Axles, under the chairmanship of Mr. A. L. C. Fell (London) has drawn up standard specifications for tramway tires and axles. In the case of tramway axles the same course has been taken as was adopted in the railway rolling stock specifications, two specifications being drafted, one with and one without a chemical analysis, in order that those who do not desire to specify an analysis may have a standard specification available.

Pending the confirmation of certain cold bend tests for axles, the specifications are ready for presentation to the Sub-Committee on Tires, Axles and Springs.

The Council are convinced that useful work is being done by the Sectional Committees of the Engineering Standards Committee, and they are therefore keeping well in touch with their activities.

Rail Corrugation.

In order that the undertaking of experiments and the general investigation of the rail corrugation phenomena might proceed continuously, the General Committee decided to appoint two sub-committees, one comprising the members in the north and the other those in the south, to undertake this work.

A number of meetings has taken place during the year, and reports have been issued by the respective sub-committees and duly submitted to the General Committee.

Additional experiments have been decided upon and the sub-committees are continuing their investigations, preparatory to a further report on this subject.

Extension of Time Limited under Special Acts.

An Act giving temporary power to Government departments to extend the time limited for the performance of duties, or the exercise of powers under special Acts, has been passed during the last session.

This Act will, no doubt, be very useful to Municipalities in connection with the extension of powers in various directions.

Meeting of Managers' Section.

At a meeting of the Managers' Section held at Salford in November, 1914, it was decided to leave the question of the 1915 meeting entirely in the hands of the Executive Council for consideration in the following spring.

The Council further considered this matter early in the year, and in view of the extraordinary circumstances still prevailing it was deemed advisable to abandon the meeting for this year.

Tramways and Light Railways Association Congress.

An invitation was received from the Tramways and Light Railways Association for two representatives to attend their Annual Congress in London on July 15 and 16, and the President (Ald. H. Linsley, J.P.) and the Hon. Secretary (Mr. C. J. Spencer) attended as representatives of the Association.

By order of the Executive Council,

H. Linsley, *President.*

C. J. Spencer, *Hon. Secretary.*

DANGERS OF REDUCED LIGHTING.

Board of Trade Report on the Manchester Accident.

In the course of his report to the Railway Department of the Board of Trade on his inquiry into the overturning of a tramcar at the corner of Alexandra Road South and Wilbraham Road, Manchester, Lt.-Col. von Donop, R.E., says that in overturning the car fell against an iron trolley standard, which checked its fall and considerably lessened the effects of it. There were about 12 passengers travelling in the car at the time, and all of these had notified the Corporation of personal injuries sustained. At the spot where the accident occurred the line makes a right-angled turn to the right, round a sharp curve.

Speed along Alexandra Road South is restricted to 16 miles an hour, and to four miles an hour round the curve leading to Wilbraham Road ; all cars have also to come to a stop before running round this curve in either direction. The car was a four-wheeled double-deck covered car, and its wheel base was 5 ft. 6 in. It was fitted with the rheostatic brake and with a hand brake, and both these brakes are reported as having been in excellent order. The curve is a compound one, having at its sharpest point a radius of 40 feet.

Owing to the orders issued under the Defence of the Realm Regulations, 1914, a large number of the lamps along Alexandra Road South are now not lighted at night at all. The following were the only lamps in the neighbourhood of the curve which were alight at the time of the accident, and even they were considerably obscured : (1) A lamp (A) on the west side of Alexandra Road South, situated 155 yards north of, that is, before reaching, the turning into Wilbraham Road. (2) A lamp (B) on the west side of Alexandra Road South, situated exactly at the turning into Wilbraham Road, and forming a landmark for that turning. (3) A lamp (C) on the west side of Alexandra Road South, situated 72 yards south of, that is, beyond, the turning into Wilbraham Road. A driver running in a southerly direction along Alexandra Road South obtains a good view of lights (A) and (C), but owing to light (B) being considerably obscured by some neighbouring trees, he does not obtain a view of it until he is within a few yards of it. The evidence of Driver Waddington, who was in charge of this car, shows that at about 9.30 p.m. he was running along that road at a speed which he estimates at about 12 miles an hour, when approaching Wilbraham Road he was turning the current on and then off again, and was watching for lamp (B), which marked the turning into that road ; before, however, he was able to see lamp (B) he saw lamp (C) situated 72 yards beyond the turning, and he admits that he mistook lamp (C) for lamp (B). He consequently allowed the car to continue running at 12 miles an hour, and it was only when he was quite close to lamp (B) that he saw it ; he at once applied his brakes, but though they acted well the car on reaching the curve heeled over and fell on to its left side. Driver Waddington had entered the Corporation's School of Instruction on July 27, and he was given his certificate as driver on August 17. From that time up to the date of this accident he was employed daily in driving. The Corporation usually obtain their drivers from the men who have been previously conductors, and who are therefore well acquainted with all their routes, but owing to the fact that over two thousand of their employees have enlisted, this method cannot be adhered to.

The general manager states that Waddington received exactly the same training in driving as is usual with their men, but that as he had never been a conductor he had not as good a knowledge of the routes as most of their drivers had. Waddington, however, himself states that he had driven several times round the curve, and that he was well acquainted with it ; he knew that he had to bring his car to a stand before rounding the curve, and he intended doing so. The car was examined after the accident, and the hand brake and rheostatic brakes were found to be in good working order. The car possessed ample stability for running round the curve at a considerably higher speed than the authorised one of four miles an hour, but at a speed of 16 miles an hour it would become liable to overturning by the action of centrifugal force.

Everything points to the overturning of this car having been entirely due to excessive speed round the curve. Waddington explains that the high speed was due to his having been misled by seeing lamp (C) beyond the turning. I visited the spot myself at night in order to judge whether this explanation was a reasonable one ; I have no hesitation in saying that the fact of lamp (C) being visible so much sooner than lamp (B) is well calculated to mislead a driver, and I am therefore prepared entirely to accept Driver Waddington's explanation. There is another lamp on the east side of Alexandra Road South, immediately opposite lamp (B), but this lamp is not at present lighted at all. If lighted, this lamp would be far more visible than lamp (B) to cars approaching the curve, both along Alexandra Road South and along Wilbraham Road, and it would therefore form a much better guide for drivers. I do not think that any objection would be raised by the military authorities if this lamp were lighted in lieu of lamp (B), and the tramway authorities have undertaken to ascertain whether this can be done.

The Board of Trade have asked the general manager of the tramways department to inform them what steps have been taken for marking the position of the curve at night.

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NO CORRUGATION ON NEW YORK CENTRAL.

In a written communication relating to the paper read by Mr. W. Willox during the last session of the Institution of Civil Engineers, Dr. P. H. Dudley, consulting engineer to the New York Central Lines, says :—

"I do not know of any corrugation in our rails, either on the Hudson or Harlem branch operated by electric traction. The rails used for electric traction on the New York Central are either our 6 in. 100 lb. or 105 lb. sections. The breadth of the head at its extreme width is 3 in., with sides inclined $\frac{1}{16}$ in. per inch of height and with $\frac{5}{16}$ in. radii for the upper corners. The top radius of the rail is 14 in. This is a broad flat top rail, quite different from the T or double-headed section used in England, and I have not noticed any corrugations whatever on rails which have been put in service the last three or four years. When electric traction was installed with electric motors to draw the former steam cars, it was noticed in one or two places that there was a slight evidence of a sway and a small increase of wear at recurring positions on a few rails, but this has practically disappeared on more recent rails.

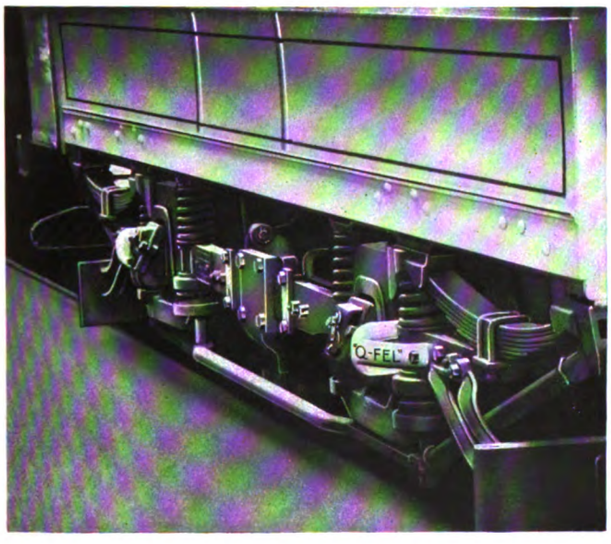
"There are two types of corrugations—long and short waves, which must be discussed in electric traction. The first I have partially described, and it no longer appears on our recent rails, while I have never noticed the short waves upon our stiff, broad, flat-topped rails.

"So far as I have observed in this country and in England the method of blooming the ingots is quite different in the ragging of the rolls. We use ragging with one sharp angle, but the other is inclined, while in England the ragging or cogging, as they term it, is done by square projections on the rolls. That type of ragging seems to affect the metal in the passes to an extent by its irregular pressure which is not completely overcome in the final rolling. The heads of the T or double-headed section have a smaller top radius with greater corner radii, consequently the actual bearing surface between the rail head and the wheel tread is smaller than in our practice, and corrugations can more readily occur.

"The long waves are due to a repeated oscillation of the equipment over the rails. The short waves produce shorter corrugations, and are noticeable for practically every inch or two in the rail top. I have never observed the latter type on our own rails, but I have seen this type to a slight extent upon rails of a different section of shorter top radius and greater corner radii."

Q-FEL AXLE-BOX GUARDS.

The simple but effective Q-Fel axle-box guard brought out by G. W. Green and Company (Feltham), Limited, serves two valuable purposes, and the fact that a set of four can be obtained for the small sum of 15s. should induce tramways managers to use them. The guard not only eliminates damage to axle-boxes



Q-Fel Axle-Box Guard in Position.

and lids, but prevents many a side panel from being damaged. Any unskilled labour can attach the guard in a few minutes. At a time like the present, when repair shop staffs are short handed this new contrivance should be welcome. It is evident that a short experience of its use will enable managers to speak of it with satisfaction.

AN ADMIRABLE RECORD.

Dick, Kerr and Company, Limited, of Abchurch Yard, Cannon Street, E.C., have just issued a handsome book for the purpose of acquainting any who are unfamiliar with the work they have done apart from and beyond their electrical manufacturing branch. The wide scope of their undertakings is shown by their having recently completed a railway 54 miles long in Portuguese East Africa, while they have just started on a new reservoir $1\frac{1}{2}$ square miles in area at Staines—a six years' job. These and many other works in India, Burma, Japan, British Columbia, Malaya, Mexico, and South America are given in some detail. Their work on tramways is only sampled, as it were, but our readers are well aware of what the firm have accomplished in this direction. The volume, of quarto size, is finely printed and illustrated, and is very attractively bound in blue cloth, lettered in gold. It contains 38 pages of clear type on fine art paper. The excellent half-tone reproductions average two to a page, and thoroughly illustrate the text. In this is included in a general way the manufacturing plant and some of the important contracts carried out by Messrs. Dick, Kerr and Company, thus forming a summary of the work executed by this purely British concern. Editions in Spanish and Portuguese are under preparation.

In a later issue we hope to publish some extracts and illustrations from the book, which is particularly encouraging as an indication of the magnitude and extent of the work carried out by British firms without fuss and without that official assistance which has been a characteristic of Teutonic enterprise in foreign countries.

INSULATORS AND OVERHEAD FITTINGS.

A well printed and profusely illustrated catalogue recently issued by Watlington and Company, Limited, of Britannia House, Milton Street, London, E.C., comprises a complete range of insulators and overhead fittings, and should be of value to all interested in the construction and maintenance of tramways, light railways, etc. A number of novelties have been introduced, while the standard fittings which have stood the test of time are shown in such a well arranged form as to material, size, weight, price, etc., that customers have only to give the catalogue number of the articles required to ensure the delivery of the exact fitting. The "Aetna" insulators and line materials, which are largely dealt with in the catalogue, have been in use on a large number of the most important tramways in Europe and America for many years and are well known for their efficiency and durability. Several pages of the catalogue, each with an illustration, show the original designs of the "West End" type of suspensions. These consist of the insulated stud bolt and a hanger casting, which includes the suspension proper, and also a metal cap for locking the insulating bolt in position and thus preventing it from becoming loose. Illustrations are also included of the "Boston" trolley line suspensions, which are similar in design and construction to the "West End" type, but of lighter weight. Another form of suspension, the details of which are shown, is the cap and cone suspensions. In this design the strain is taken by malleable iron castings, which spread out sufficiently to protect the insulation from accidental blows from the trolley. Both the cap and the cone sections are of "Aetna" insulating material. "Elephant" strain insulators, with drop-forged galvanised steel terminals and "Giant" strain insulators with malleable iron terminals in various sizes are shown, together with "Brooklyn" strain insulators, insulated drop-forged steel turnbuckles and the standard type globe strain of the tee and basket design, all being moulded with "Aetna" insulating material. The improved porcelain pole strap insulators, and also the strain insulators of the same type, are shown in full size illustrations, and of each of these there is also a line drawing giving the various dimensions and distances between centres. Section insulators of various types, mechanical ears, splicing ears, frogs and crossings, both of fixed and adjustable patterns, insulated and uninsulated, are all included, and together with a range of flexible suspensions and guard wire supports, overhead line tools, etc., make up a very useful catalogue.

Manaos Tramways Company.—At the annual meeting of shareholders in London, Mr. George Watson said that the relationship between the company and the Government was cordial, and contracts were loyally carried out. Although the fall in the exchange meant a loss of £6,180 for the past year, the Government were able recently to authorise the issue of another 350,000 contos of paper money, a step which would have been impossible ten or fifteen years ago. The Amazon Valley had suffered severely on account of the rubber position, but the country was now developing other industries, which would assist in securing the future prosperity of Brazil.

Manila Electric Railroad and Lighting Corporation.—A dividend of $1\frac{1}{2}$ per cent. ($1·50 per share) for the quarter ended September 30 on the Common stock is announced. A year ago the dividend was $1\frac{3}{4}$ per cent.

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RAILLESS TROLLEY CAR COSTS AT LEEDS AND BRADFORD.

LEEDS.

Appended will be found the statement of accounts of the railless trolley route of Leeds Corporation Tramways for the year ended March 31 last. The route length now in operation is 3 miles 5 furlongs 76 yards, and additional routes totalling 8 miles 3 furlongs 197 yards have been authorised, some portions being now in course of construction.

	1914–15.		1913–14.	
	Amount.	Av'ge per car mile.	Amount.	Av'ge per car mile.
EXPENDITURE.	£	d.	£	d.
To Traffic Expenses:—				
Wages of motormen and conductors	530	1·510	485	1·55
Cleaning and oiling cars	176	·500	140	·45
Ticket check	5	·015	4	·02
Uniforms and badges	13	·037	13	·04
Licenses	3	·008	3	·01
	727	2·070	646	2·07
General Expenses:—				
Rates	29	·083	23	·07
Insurances	47	·135	41	·13
	76	·218	65	·20
General Repairs:—				
Electrical equipment of line... ...	28	·081	24	·08
Cars (including tires)	716	2·040	638	2·04
	744	2·121	662	2·12
Power Expenses	107	·307	136	·44
Total working expenses ...	1,656	4·716	1,511	4·83
To balance carried down	803	2·286	628	2·01
	£2,459	7·002	£2,139	6·84
INCOME.				
Traffic Receipts	2,449	6·974	2,132	6·82
Advertising on Cars	10	·028	7	·02
	£2,459	7·002	£2,139	6·84
NET REVENUE ACCOUNT.				
To Interest and Sinking Fund:—				
Interest on Capital	271	·771	271	·86
Sinking Fund	440	1·253	440	1·41
Balance	91	·262	—	—
	802	2·286	711	2·27
By Balance brought down from Revenue Account	802	2·286	628	2·01
Balance	—	—	82	·26

Plymouth's Acquisition of Devonport's Tramways.—On October 2, the Devonport Tramways Company's undertaking was taken over by Plymouth Corporation. The Devonport members of the Plymouth Tramways Committee have approved of Mr. C. R. Everson's (general manager) recommendations as regards fares and distances, with one exception, which has been rectified. Alderman S. H. Phillips, chairman of the committee, has expressed regret that owing to the war it is impossible at present to obtain the materials required for making a connection between the two systems. Unfortunately the Council, by 29 votes to 13, have rejected the Plymouth Committee's proposal to abolish halfpenny fares, although Alderman Phillips pointed out that such fares did not earn a large sum of money, but from time to time caused considerable delay. Representatives of wards at the ends of systems were from time to time urged to ask for similar fares in other places, though the Council resisted them. The experience of the country was overwhelmingly opposed to halfpenny fares.

Reduction of Wages by Arbitration.—In consequence of decreased earnings, due to depression and "jitney" motor car competition, the British Columbia Electric Railway Company, on the expiration of the agreement with their employees on June 30, notified the employees that they desired to make a 10 per cent. reduction in wages throughout. The men's Union rejected the proposal, which therefore went before an arbitration board appointed by the Government under the Industrial Disputes Investigation Act. The decision takes the form only of a recommendation to the parties, and nothing in the Act restrains lock-outs or strikes. The Board was composed of Justice McDonald (chairman), and a representative each of the company and the employees. By a majority, the Board have recommended an average reduction of 7 per cent., the reduction in case of the car crews being a little more than 8 per cent. It is recommended that the new agreement should expire on June 30, 1917. At a mass meeting of the employees, it was announced that the International Executive of the Union had refused to sanction a strike. The company subsequently agreed that the award should be a war measure, its term being until six months after the cessation of hostilities, with a minimum of twelve months and a maximum of twenty-two months. A ballot of the employees resulted in the acceptance of the amended award.

BRADFORD.

Subjoined is the official statement of accounts of the railless traction routes worked in connection with Bradford Corporation Tramways department during the year ended March 25 last:—

	1914–15.		1913–14.	
	Amount.	Av'ge per car mile.	Amount.	Av'ge per car mile.
EXPENDITURE.	£	d.	£	d.
Traffic Expenses:—				
Superintendence	11	·015	3	·014
Wages, motormen and conductors ...	1,499	2·025	457	2·208
Wages other traffic employees ...	94	·127	26	·128
Cleaning and oiling cars	193	·261	57	·277
Fuel, light and water (depots) ...	132	·178	20	·097
Ticket check	105	·142	29	·138
Uniforms and badges	217	·294	18	·088
Miscellaneous	89	·120	27	·131
	2,340	3·162	637	3·081
General Expenses:—				
Salaries, general officers and staff ...	104	·141	28	·134
Administration and estab. expenses ...	21	·028	6	·020
Store expenses	11	·015	3	·017
Rates and taxes	149	·202	32	·156
Printing and stationery	24	·032	5	·022
Fuel, light, water (offices)	8	·011	3	·014
Accidentinsurance and compensations	100	·135	4	·020
Fire and other insurances	15	·020	2	·009
Miscellaneous	24	·032	18	·088
	456	·616	101	·480
General Repairs and Maintenance:—				
Electrical equipment of line... ...	14	·019	45	·219
Buildings and fixtures	42	·057	7	·034
Sundry plant	64	·086	6	·029
Cars	1,327	1·793	477	2·306
	1,447	1·955	535	2·588
Power Expenses:—				
Cost of current at 1d. per Board of Trade Unit	610	·824	233	1·128
Total working expenses	£4,853	6·557	£1,505	7·285
REVENUE.				
Traffic revenue	4,316	5·830	1,506	7·281
Balance carried to net revenue ...	538	·727	1	·005
	£4,854	6·557	£1,507	7·286

In his annual report on the tramways for 1914–15, Mr. C. J. Spencer, general manager, states that extensions of the railless trolley system aggregating 8 miles 330 yards have been made this year as follow:—Odsal Top to Oakenshaw, 1 mile 1,122 yards; Dudley Hill to Bankfoot, 1 mile 1,254 yards; Killinghall Road (Leeds Road) to Bolton, 2 miles 242 yards; Forster Square to Frizinghall, via Canal Road, 2 miles 1,232 yards. Adverting to criticisms of the railless trolley system,

Mr. Spencer observes that it would not be correct to state that either a profit has been made or a loss incurred on the railless traction routes, because their feeding value to tramway routes, an important function of these cars, is not, and cannot be taken into consideration in the accounts. The routes along which the cars run are routes upon which tramways could not be laid without incurring very heavy capital expenditure, and this method of traction was primarily adopted because of its cheapness in capital construction and operation, and not because it was better than a tramway. He therefore submits that an efficient means of transit has been afforded to districts which could not expect a tramway service. Petrol motor omnibuses would have been an alternative, but judging by the published costs of various omnibus enterprises throughout the country, Bradford Corporation are running railless cars at a less figure per car mile and giving an equal if not a better service.

In referring to the assertion that the roads are damaged considerably by railless trolley cars, Mr. Spencer states that experience has proved that water-bound macadam roads are not suitable for modern heavy traffic, but given a road properly constructed to carry the ordinary heavy motor traffic of to-day, the railless trolley car, and the motor omnibus, with their rubber tires, are not extraordinary wearers of roads. The complaint that trolley cars raise dust and splash mud is common to them, motor omnibuses, and all other fast vehicles, and is fair criticism where such vehicles are running over unsuitable roads. The problem, therefore, is one of making a roadway suitable for modern conditions. Special canvas vestibules have proved effective, it is stated, in protecting passengers from the dust nuisance. Seventeen railless electric vehicles have been designed, built and equipped by the department and are in regular service.

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COMPARATIVE ELECTRIC TRAMWAY ACCOUNTS

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Year Ended.	Electric Traction Inaugurated.	System.	Line open (single track). Mls.	Chs.	Borrowing Powers.	Borrowing Powers Exercised.	Unexhausted Borrowing Powers.	Total Capital Expenditure.	Capital Expenditure per Mile of Single Track.	Loans Outstanding.	Loans Repaid and Sinking Fund.	Depreciation, Renewal and Reserve Funds.	Gross Receipts. Traffic.	Other.	Total.
Aberdeen ..	*May 31, 1915	Dec., 1899	E.	27	56	415,000	366,332	48,668	366,332	13,225	184,118	234,194	189,803	86,614	1,388	88,002
Accrington ..	Mar. 31, 1914	Aug., 1907	,,	10	53	181,925	133,875	48,050	134,734	12,636	113,870	20,864	16,581	29,843	350	30,193
Ashton-u-Lyne.	Mar. 25, 1914	Aug., 1902	...	8	15	130,070	109,814	20,256	109,814	13,412	73,958	32,270	2,950	23,341	677	24,019
Ayr	May 15, 1914	Sept., 1901	,,	9	30	128,000	98,630	29,369	100,841	10,756	79,171	19,460	16,489	18,315	1,062	19,377
Birmingham ..	Mar. 31, 1914	Jan., 1904	,,	114	44	2,577,611	2,352,104	225,507	2,334,437	20,379	1,913,559	438,545	186,154	628,016	7,455	635,471
Blackburn ..	*Mar. 25, 1915	Mar., 1899	,,	24	63	408,174	342,474	65,700	336,258	13,566	354,600	191,985	3,718	65,158	3,144	68,302
Blackpool ..	*Mar. 31, 1915	June, 1899	,,	(p)21	51	460,473	316,005	144,468	316,005	14,604	316,005	138,577	19,698	75,344	761	76,105
Bolton ...	*Mar. 31, 1915	Dec., 1899	,,	47	69	551,092	551,092	Nil	570,981	11,930	348,111	202,980	43,059	140,182	1,228	141,410
Bradford ..	*Mar. 31, 1915	July, 1898	,,	(h)118	9	1,280,788	1,043,788	237,000	1,043,054	8,831	634,618	439,321	75,208	309,320	20,568	329,888
Brighton ...	*Mar. 31, 1915	Nov., 1901	,,	17	15	378,093	279,978	98,115	280,392	16,314	211,268	69,124	7,562	54,413	2,113	56,526
Burnley	*Mar. 31, 1915	Dec., 1901	,,	22	18	388,052	326,077	61,975	232,580	10,465	170,852	72,664	29,550	77,161	1,306	78,467
Burton-on-Trent	Mar. 31, 1914	Aug., 1903	,,	10	50	108,632	104,562	4,070	106,275	10,121	49,239	55,323	10,134	15,010	1,497	16,507
Bury	*Mar. 31, 1915	June, 1903	,,	(b)36	10	407,800	284,745	123,055	293,237	12,826	254,832	55,416	33,960	68,740	276	69,016
Chester	Mar. 25, 1914	April, 1903	,,	6	35	92,991	82,380	10,611	82,934	12,883	68,477	14,121	4,282	12,793	480	13,273
Chesterfield ..	Mar. 31, 1914	Dec., 1904	,,	5	8	98,000	73,500	24,500	69,810	13,663	57,660	13,820	6,307	13,608	465	14,073
Colchester ..	*Mar. 31, 1915	July, 1904	,,	7	75	70,748	69,555	1,193	69,471	8,736	48,360	22,007	Nil.	13,413	380	13,793
Croydon	*Mar. 31, 1915	(q) Sept., 1901	,,	17	50	287,689	287,689	Nil	286,765	16,271	222,223	107,039	41,643	87,833	781	88,614
Darlington ..	Mar. 31, 1914	June, 1904	,,	8	71	107,500	77,832	29,668	77,786	8,752	56,178	23,338	6,806	12,976	261	13,237
Darwen	*Mar. 31, 1915	Oct., 1900	,,	7	13	93,400	86,300	7,100	87,199	12,174	51,200	33,555	9,396	14,645	988	15,633
Derby	Mar. 31, 1914	July, 1904	,,	22	20	239,980	239,980	Nil	245,332	11,026	177,676	67,656	(l)32,356	£51,126	1,048	52,174
Doncaster ..	Mar. 31, 1914	June, 1902	,,	12	58	...	...	...	107,921	8,481	94,700	16,581	1,442	22,890	318	23,208
Dundee	*May 15, 1915	July, 1900	,,	28	32	(f)	362,789	...	371,145	13,068	266,027	96,762	92,694	66,320	1,954	68,274
East Ham ..	Mar. 31, 1914	June, 1901	,,	14	5	190,643	190,242	401	191,654	13,127	140,457	65,478	3,453	54,079	836	54,915
Exeter	Mar. 31, 1914	April, 1905	,,	7	0	106,000	86,111	19,889	86,111	12,301	67,354	19,249	6,290	17,489	97	17,586
Gloucester ..	*Mar. 31, 1915	April, 1904	,,	15	1	191,000	144,333	46,667	147,783	9,846	104,965	22,901	1,000	16,693	1,114	17,807
Halifax	*Mar. 31, 1915	June, 1898	,,	55	39	449,263	417,466	31,797	420,185	7,570	283,249	129,670	36,442	111,792	1,378	113,170
Ilford	Mar. 31, 1914	Mar., 1903	,,	11	28	149,633	149,633	Nil	149,574	13,178	101,842	44,791	2,297	23,485	2,308	25,793
Ilkeston	Mar. 31, 1914	May, 1903	,,	3	56	64,214	47,000	17,214	47,833	13,436	31,462	16,422	...	6,915	171	7,086
Ipswich	Mar. 31, 1915	Nov., 1903	,,	14	70	116,471	114,300	2,171	115,676	7,776	94,894	115,549	15,940	22,796	493	23,289
Keighley	Mar. 31, 1913	Oct., 1904	,,	6	9	50,934	47,328	3,606	47,328	7,745	32,468	16,961	942	8,845	313	9,158
Kilmarnock ..	May 15, 1914	Dec., 1904	,,	5	47	65,000	52,795	12,205	53,281	9,536	47,250	8,707	5,298	9,088	265	9,353
Kirkcaldy ..	*May 15, 1915	Feb., 1903	,,	8	65	213,000	97,868	115,132	97,868	11,105	76,466	21,402	5,223	16,564	412	16,976
Lancaster ..	Mar. 31, 1914	Jan., 1903	,,	4	65	...	45,700	...	43,684	9,077	30,450	15,350	3,074	5,779	158	5,937
Leith	May 15, 1914	Aug., 1905	,,	17	73	275,000	238,000	37,000	236,877	13,211	179,350	58,650	3,045	36,555	1,170	37,725
Leyton	Mar. 31, 1914	Dec., 1906	,,	18	8	324,201	324,145	56	295,376	16,319	240,741	57,244	2,654	69,148	1,541	70,689
Lincoln	*Mar. 31, 1915	Nov., 1905	S.	2	77	98,519	44,947	53,572	44,987	15,185	40,226	12,529	(l) 692	6,435	117	6,552
Liverpool ...	Dec. 31, 1914	Nov., 1898	E.	124	0	2,622,786	2,057,850	564,936	2,062,391	16,741	1,168,685	1,177,949	366,545	684,026	13,050	697,076
Lowestoft ..	Sep. 30, 1914	July, 1903	,,	4	6	96,230	91,178	5,052	91,178	22,375	75,480	17,614	Nil	11,357	373	11,730
Maidstone ..	Mar. 31, 1914	July, 1904	,,	7	3	82,932	82,932	Nil	79,098	11,239	65,574	17,358	...	10,391	575	10,966
Manchester ..	*Mar. 31, 1915	June, 1901	,,	203	31	2,361,038	2,207,215	153,823	2,216,009	10,895	1,648,183	548,499	438,497	887,763	14,112	901,875
Nelson	Mar. 31, 1914	Feb., 1903	,,	3	69	38,000	37,885	115	37,885	9,808	29,145	8,740	...	10,801	52	10,853
Newport (Mon.)	Mar. 31, 1914	April, 1903	,,	14	28	219,250	196,250	23,000	194,983	13,588	159,734	45,350	4,055	40,151	1,039	41,190
Nottingham ...	*Mar. 31, 1915	Jan., 1901	,,	44	20	...	...	...	733,674	16,586	473,999	261,364	56,626	176,289	3,026	179,315
Oldham	Mar. 25, 1914	May, 1902	,,	28	6	509,723	442,047	67,676	444,565	15,835	311,148	133,167	8,455	114,481	1,689	116,170
				(b) 8	31											
Perth ...	*May 15, 1914	Nov., 1913	,,	6	75	90,000	78,350	11,650	78,629	11,334	...	...	...	8,944	928	9,872
Plymouth ..	Mar. 31, 1914	Sept., 1899	,,	15	0	182,856	181,479	1,377	219,417	14,628	86,903	89,493	24,252	39,989	891	40,880
Pontypridd ..	*Mar. 31, 1914	Mar., 1905	,,	8	48	...	...	...	133,143	15,482	...	...	...	23,280	320	23,600
Rawtenstall ..	*Mar. 31, 1915	May, 1909	,,	15	71	193,290	182,172	11,118	182,276	11,709	150,324	31,848	3,051	24,460	1,076	25,536
Rochdale	*Mar. 31, 1915	May, 1902	,,	(i)40	2	356,991	347,782	9,209	353,200	15,407	347,782	108,034	16,000	77,660	5,742	83,402
Rotherham ..	*Mar. 31, 1915	Jan., 1903	,,	12	2	342,200	188,326	153,874	184,178	15,316	150,485	33,473	21,771	43,834	59	43,893
			R.T	...		...	...	...	...	...	...	...	...	...	...	...
Salford	Mar. 31, 1914	Oct., 1901	E.	75	64	1,050,666	724,469	326,197	723,923	9,554	532,821	191,648	28,492	272,758	54	272,812
Southampton ..	*Mar. 31, 1915	Jan., 1900	,,	18	54	280,452	260,699	19,753	259,834	13,913	158,729	99,470	14,251	68,042	2,996	71,038
Southend-on-Sea	Mar. 31, 1913	July, 1901	,,	11	49	130,000	129,961	39	143,808	12,384	116,940	12,784	3,045	34,453	465	34,918
Southport ..	Mar. 31, 1914	July, 1900	,,	(d) 10	63	294,000	197,730	94,270	196,178	9,921	150,250	47,480	442	18,391	455	18,846
South Shields ..	*Mar. 31, 1915	Mar., 1906	,,	10	21	251,882	184,056	67,826	181,097	17,646	155,214	37,314	30,837	39,275	570	39,845
Staly'ge, H., M., D.	*Mar 31, 1915	May, 1904	,,	27	57	325,270	280,990	44,280	279,778	10,096	209,387	71,603	1,211	37,490	130	37,620
Stockport ..	Mar. 31, 1914	Aug., 1901	,,	27	5	318,847	234,500	84,347	251,514	9,294	158,391	76,109	37,179	66,715	1,322	68,037
Sunderland ...	*Mar. 31, 1915	Aug., 1900	,,	20	28	308,699	303,211	5,488	306,766	15,074	161,996	132,265	45,044	75,229	386	75,615
Swindon	Mar. 31, 1914	Sept., 1904	,,	4	42	...	...	...	44,216	9,771	33,861	11,738	7,237	8,602	309	8,911
Wallasey ..	Mar. 31, 1915	Mar., 1902	,,	19	77	208,867	195,290	13,577	222,027	11,122	159,306	72,879	10,612	63,690	815	64,505
Walsall	Dec. 31, 1914	Dec., 1902	,,	19	44	188,145	188,100	45	182,926	9,357	154,044	63,649	34,960	33,311	778	34,089
Walthamstow ..	Mar. 31, 1915	June, 1905	,,	13	30	198,000	194,000	4,000	190,477	14,251	168,248	25,249	...	41,346	443	41,789
Warrington ...	Mar. 31, 1914	April, 1902	,,	9	52	103,674	102,896	778	102,128	10,583	70,476	32,422	10,000	23,232	521	23,753
West Ham ..	*Mar. 31, 1915	Feb., 1904	,,	30	4	578,478	551,588	26,890	556,878	18,532	469,051	123,888	26,236	147,703	4,509	152,212
West Hartlepool	*Mar. 31, 1915	Feb., 1904	,,	8	63	85,494	80,330	5,164	81,731	9,301	76,501	3,682	4,614	19,011	494	19,505
Wigan	*Mar. 31, 1915	April, 1901	,,	30	73	502,513	491,007	11,506	481,577	15,579	382,490	157,287	5,034	75,270	2,107	77,377
Wolverhampton	*Mar. 31, 1915	April, 1902	S.	21	40	279,733	268,185	11,548	292,361	13,596	209,497	71,812	53,987	54,593	730	55,323
Yarmouth (Gt.).	Mar. 31, 1914	June, 1902	E.	14	58	149,600	124,750	24,850	126,363	9,207	116,450	25,996	9,075	25,712	527	26,239
York	Mar. 31, 1914	Jan., 1910	,,	12	20	157,150	157,150	340	156,810	12,853	152,470	6,323	5,092	26,133	642	26,775

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	*Mar. 31, 1915	Nov., 1905	E.	98	54	1,528,146	1,381,200	136,946	1,465,506	14,702	1,343,000	257,730	96,622	266,249	3,988	270,237
Bexley	Mar. 31, 1914	Oct., 1903	,,	6	42	100,798	98,812	1,986	98,408	15,376	75,408	23,403	942	14,698	1,649	16,346
Birkenhead	Mar. 31, 1914	Feb., 1901	,,	24	7	376,398	369,528	6,870	371,097	15,406	239,201	130,267	22,655	67,725	4,300	72,025
Bournemouth ...	Mar. 31, 1914	July, 1902	,,	(e)29	62	471,850	432,440	39,410	443,006	19,821	286,385	146,054	18,409	104,353	616	104,969
Cardiff	Mar. 31, 1914	May, 1902	,,	31	66	830,382	787,292	43,090	786,510	24,714	514,059	273,232	104,002	141,519	24,681	166,200
Coventry ...	Mar. 31, 1914	Jan., 1912	,,	15	61	251,014	235,574	15,440	229,197	14,541	230,596	8,517	3,983	42,751	733	43,484
Glasgow	*May 31, 1915	Oct., 1898	,,	198	10	4,564,266	3,694,143	870,123	3,751,708	19,127	2,411,868	1,282,275	2,326,543	1,070,694	6,184	1,076,878
				(b) 2	53											
Huddersfield ...	*Mar. 31, 1915	Feb., 1901	,,	56	4	772,662	467,142	305,520	477,919	8,526	281,927	194,599	7,522	124,200	2,859	127,059
Hull ...	Mar. 31, 1915	July, 1899	,,	33	12	662,074	594,626	67,448	596,092	17,982	579,628	183,392	147,663	161,750	1,280	163,030
Leeds	*Mar. 31, 1915	Aug., 1897	,,	115	71	1,907,865	1,814,758	93,107	1,678,844	14,487	1,400,687	590,421	4,961	429,902	4,038	433,940
Leicester ..	Dec. 31, 1914	May, 1904	,,	37	0	1,006,946	818,073	188,290	828,953	22,404	674,936	147,944	91,843	149,664	20,571	170,235
London	Mar. 31, 1915	...	H.	9	67									10,261	540	10,801
		May. 1903	C.E	274	35	(c)	(c)	(c)	13,744,806	..	9,836,187	3,786,403	565,095	2,323,130	65,916	2,389,046
N'castle-on-Tyne	Mar. 31, 1914	Dec., 1901	E.	62	72	1,522,010	1,277,747	244,263	1,284,380	20,428	929,766	428,119	94,337	251,024	10,177	261,201
Northampton ...	*Mar. 31, 1915	July, 1904	,,	12	37	239,800	147,255	92,545	173,019	13,883	118,932	48,610	14,628	30,775	534	31,309
Portsmouth ...	*Mar. 31, 1915	Sep., 1901	,,	34	48	708,619	708,619	Nil	731,174	21,132	423,103	285,516	81,715	121,909	2,082	123,991
Preston	Mar. 31, 1914	June, 1904	,,	17	16	224,102	187,269	36,833	187,269	10,888	117,315	47,130	39,392	45,618	328	45,946
Reading	*Mar. 31, 1915	July, 1903	,,	13	14	235,000	234,000	1,000	237,102	17,996	155,419	75,406	19,471	35,608	1,074	36,682
Sheffield	*Mar. 25, 1915	Sep., 1899	,,	79	8	1,782,471	1,484,400	298,071	1,558,246	19,703	1,122,482	512,567	34,450	391,535	2,996	394,531
Wellington, N.Z.	Mar. 31, 1914	...	,,	31	55	496,423	496,423	...	628,151	19,821	496,423	46,836	120,191	157,096	1,161	158,257

C—Electric conduit system. E—Electric trolley system. H—Horse lines RT—Railless trolley system. S—Surface contact system.
(b) Includes leased lines. (c) Conferred by Annual Money Act, which limits amount for each financial year. Powers not exercised are lapsed
(d) Not including 8 miles 78 chains leased lines. (e) Includes 7 miles 34 chains leased lines. (f) Unlimited. (h) Includes 9 miles 26 chains railless trolley routes.
(i) 17 mi. 8 chn. single track leased. (l) Including Insurance. (p) Including leased lines. (q) Corporation working commenced June, 1906.

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COMPARATIVE ELECTRIC TRAMWAY ACCOUNTS

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Working Expenses.					Gross Profit on Working.	Additions to Gross Profit	Deductions from Gross Profit.						Net Surplus + or Deficit −
	Traffic.	General.	Repairs & Maintenance.	Power.	Total.			Interest.	Sinking Fund.	Income Tax.	Depreciation & Renewal	Sundries.	Total.	
Aberdeen	23,291	12,148	7,920	8,166	51,525	36,477	...	4,789	5,179	...	13,840	(i) 1,669	25,477	+ 11,000
Accrington	7,570	2,792	2,268	4,880	17,510	12,683	...	3,969	3,783	198	3,100	65	11,115	+ 1,568
Ashton-under-Lyne	5,149	1,682	3,053	3,372	13,256	10,763	...	2,590	3,760	477	800	39	7,666	+ 3,097
Ayr	4,206	2,093	1,905	2,457	10,661	8,716	...	(h) 2,558	1,744	164	2,503	606	7,575	+ 1,141
Birmingham	183,119	59,947	88,698	113,743	445,507	189,964	8,487	68,478	53,804	...	...	197	122,479	+ 75,972
Blackburn	16,859	6,197	14,451	9,421	46,928	21,374	287	(h) 4,388	15,450	251	1,572	...	21,661	...
Blackpool	17,632	(i)7,755	9,239	10,225	44,851	31,254	...	(h) 9,878	7,640	...	...	...	17,518	+ 13,736
Bolton	30,044	(q) 9,486	15,912	20,689	76,131	65,279	857	(h) 10,525	17,520	1,713	18,339	(i) 981	49,078	+ 17,058
Bradford	91,597	(i)36,890	64,670	52,938	246,095	83,793	4,525	22,087	24,164	5,422	7,832	4,203	63,708	+ 24,610
Brighton	14,152	(i) 6,759	13,690	8,384	42,985	13,541	55	7,661	5,917	...	...	...	13,578	+ 18
Burnley	21,142	(i)10,079	9,141	17,955	58,317	20,150	...	6,796	8,284	1,515	...	(f) 1,890	18,486	+ 1,664
Burton-on-Trent	5,442	1,502	2,562	3,154	12,660	3,847	(q) 1,524	1,364	1,344	...	1,500	...	4,208	+ 1,163
Bury	16,129	4,971	7,162	7,504	35,766	33,250	303	(h) 7,037	6,026	825	2,472	(w) 11,193	27,553	+ 6,000
Chester	3,290	1,534	1,208	2,096	8,128	5,145	158	(h) 2,754	1,018	...	...	...	3,772	+ 1,531
Chesterfield	3,214	1,368	2,936	2,192	9,710	4,363	269	2,275	1,900	...	...	...	4,175	+ 457
Colchester	3,045	1,372	2,370	2,783	9,570	4,223	28	(h) 1,986	2,496	...	...	(i) 172	4,654	− 403
Croydon	31,319	(i) 9,151	14,128	17,684	72,282	16,332	749	7,889	7,415	1,587	...	...	16,891	+ 190
Darlington	4,305	812	1,995	2,012	9,124	4,113	101	(h) 1,944	1,996	102	469	...	4,511	− 297
Darwen	4,064	1,146	3,260	2,653	11,123	4,510	222	2,221	2,190	...	1,050	...	5,461	− 729
Derby	E 17,320 H 540	2,906 ...	5,499 81	8,610 ...	34,335 621	17,839 def. 173	239	6,236	3,464	...	5,536	(l) 185	15,421	+ 2,657
Doncaster	4,969	1,342	6,550	4,166	17,027	6,181	16	2,935	1,840	138	572	58	5,543	+ 654
Dundee	17,829	(i)7,398	7,445	10,686	43,358	24,916	...	8,990	6,700	323	7,842	...	23,855	+ 1,061
East Ham	18,739	6,802	12,067	10,521	48,129	6,786	...	(h) 5,570	6,882	...	...	573	13,025	− 6,239
Exeter	4,888	1,373	1,483	3,827	11,571	6,015	...	(h) 2,305	1,885	101	...	...	4,291	+ 1,724
Gloucester	7,250	1,643	2,975	1,836	13,704	4,103	...	(h) 5,362	1,881	370	...	...	7,613	− 3,510
Halifax	30,501	7,877	13,529	21,597	73,504	39,321	345	10,424	12,106	...	(y) 925	(i) 2,632	23,455	+ 16,211
Ilford	9,916	2,431	3,740	4,791	20,878	4,915	557	3,969	5,070	...	...	...	9,039	− 3,567
Ilkeston	2,262	789	1,378	1,460	5,889	1,197	160	1,450	1,532	90	...	96	3,168	− 1,811
Ipswich	8,801	1,962	5,033	3,494	19,290	3,999	(u) 4,877	(h) 3,660	2,207	...	3,421	(i) 237	9,525	- 649
Keighley	2,692	768	893	1,612	5,971	3,187	179	1,116	1,881	...	...	(m) 369	3,366	...
Kilmarnock	3,195	746	1,327	1,717	6,985	2,368	...	1,628	1,252	...	1,160	...	4,040	− 1,672
Kirkcaldy	4,811	1,416	2,312	2,912	11,451	5,525	68	2,604	2,411	...	409	136	5,560	+ 33
Lancaster	2,290	522	841	1,594	5,247	690	52	1,158	1,511	...	...	...	2,669	− 1,927
Leith	9,742	3,131	5,080	3,920	21,873	15,852	242	(h) 6,211	7,850	...	2,274	67	16,402	− 308
Leyton	(p) 22,360	8,611	13,711	12,923	57,605	13,084	133	10,007	8,461	...	...	202	18,670	− 5,453
Lincoln	1,446	656	967	872	3,941	2,611	47	1,529	1,071	...	...	(i) 6	2,606	+ 52
Liverpool	192,352	69,830	83,100	123,527	468,809	228,267	25,231	50,082	63,726	...	(d) 34,821	(e) 4,869	153,498	+ 100,000
Lowestoft	3,405	655	1,552	2,323	7,935	3,795	..	2,441	2,251	...	...	...	4,692	- 897
Maidstone	2,609	1,062	1,686	1,934	7,291	3,675	57	2,470	1,969	...	...	114	4,553	− 821
Manchester	273,002	(i)117,573	85,280	128,350	604,205	297,670	14,615	(h) 58,243	57,599	13,790	48,584	(e) 34,069	212,285	+ 100,000
Nelson	2,537	684	1,525	2,123	6,869	3,984	...	978	1,026	...	...	...	2,004	+ 1,980
Newport (Mon.)	10,513	4,240	13,070	6,670	34,493	6,697	925	5,850	4,231	...	...	158	10,239	− 2,617
Nottingham	48,272	14,674	17,408	30,692	111,046	68,269	...	16,444	21,121	...	...	(i) 2,040	39,605	+ 28,664
Oldham	26,908	8,585	22,246	20,564	78,303	37,867	1,317	15,559	11,718	1,352	...	(g) 5,654	34,283	+ 4,901
Perth	...	...	...	...	6,002	3,870	...	...	...	...	...	...	...	...
Plymouth	8,430	3,896	4,514	8,026	24,866	16,014	1,257	4,282	3,141	690	5,121	...	13,234	+ 4,037
Pontypridd	...	...	...	...	16,111	...	...	...	...	..	...	...	...	...
Rawtenstall	6,126	2,446	3,187	4,273	16,032	9,504	85	5,483	6,493	...	...	...	11,976	− 2,387
Rochdale	19,308	5,063	10,984	11,537	46,892	36,510	1,636	11,478	9,594	2,038	...	(i) (s) 10,752	33,862	+ 4,284
Rotherham	E 11,039 RT ...	4,071 ...	5,864 ...	8,718 ...	29,692 ...	14,201 ...	195 ...	5,349 ...	3,465 ...	... ...	4,082 ...	... ...	12,896 ...	+ 1,500 ...
Salford	79,460	23,804	25,203	50,303	178,770	94,042	5,044	(h) 17,392	22,470	2,760	5,674	(k) 28,790	77,086	+ 22,000
Southampton	21,466	(i) 6,862	9,433	12,545	50,306	20,732	(t) 6,757	7,564	7,557	952	5,000	...	21,073	+ 6,416
Southend-on-Sea	8,046	2,260	3,534	6,187	20,027	14,891	4,228	(h) 3,834	1,753	...	4,017	..	9,605	+ 9,514
Southport	4,754	2,126	3,103	2,999	12,982	5,864	6,379	6,516	5,018	...	2,144	...	13,678	− 1,435
South Shields	9,249	(i) 5,225	4,156	6,880	25,510	14,335	140	5,230	3,651	...	...	...	8,881	+ 5,594
Staly'dge, H., M., D	12,818	(r) 5,022	7,448	5,761	32,049	5,571	...	7,485	7,786	...	400	397	16,068	− 10,497
Stockport	14,828	4,583	10,045	5,964	35,420	32,617	1,170	5,432	8,909	1,163	2,369	(j) 3,414	21,287	+ 12,500
Sunderland	19,807	5,608	4,867	11,267	41,549	34,066	265	(h) 6,464	10,374	1,218	10,875	400	29,331	+ 5,000
Swindon	2,854	828	1,534	1,850	7,066	1,845	45	1,215	1,422	...	...	...	2,637	− 747
Wallasey	18,736	(i) 6,704	6,213	10,801	42,454	22,051	1,249	5,520	5,072	...	...	634	11,226	+ 12,074
Walsall	8,510	3,326	4,315	5,670	21,821	12,268	1,339	4,962	3,975	551	640	...	10,128	+ 3,479
Walthamstow	14,417	2,972	8,845	8,546	34,780	7,009	30	(h) 6,427	3,468	...	...	(i) 712	10,607	− 3,568
Warrington	5,999	1,834	3,973	3,411	15,217	8,536	537	2,481	3,353	...	...	...	5,834	+ 3,239
West Ham	52,659	†14,531	33,326	19,420	119,936	32,276	243	18,875	12,679	...	692	...	32,246	+ 273
West Hartlepool	4,791	1,586	2,956	2,241	11,574	7,931	3	2,569	1,847	...	..	(f) 500	4,916	+ 3,018
Wigan	17,340	5,252	12,768	10,817	46,177	31,200	331	(h) 13,866	13,101	...	...	3,662	30,629	+ 902
Wolverhampton	13,031	(i) 6,239	8,594	7,202	35,066	20,257	(x) 2,535	7,760	5,669	203	5,416	...	19,048	+ 3,744
Yarmouth (Gt.)	7,756	1,849	3,052	4,951	17,608	8,631	75	(h) 4,065	2,826	...	1,815	...	8,706	...
York	8,713	2,028	1,936	5,259	17,936	8,839	...	(h) 4,609	1,706	...	...	...	6,315	+ 2,524

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	75,752	17,245	35,294	28,622	156,913	113,325	...	48,342	31,277	1,478	17,879	2,164	101,140	+ 12,185
Bexley	3,282	1,382	*3,554	828	(s) 11,630	4,716	...	2,794	2,509	...	324	...	5,627	− 911
Birkenhead	17,015	5,374	11,759	10,744	44,892	27,133	83	(h) 11,577	9,499	373	5,712	55	27,216	...
Bournemouth	24,154	8,350	10,307	16,200	59,011	45,958	2,550	(u) 10,265	15,255	...	12,871	(e) 8,117	46,508	+ 2,000
Cardiff	44,037	11,121	18,146	26,260	99,564	66,636	2,592	23,941	23,014	2,835	6,946	...	56,736	+ 12,492
Coventry	12,861	4,471	7,945	3,839	29,116	14,368	478	8,506	5,230	...	277	414	14,427	+ 419
Glasgow	345,625	(i)193,837	144,530	51,995	735,987	340,891	65,826	78,797	105,492	22,790	172,310	14,377	393,766	+ 12,951
Huddersfield	33,571	(i) 7,911	20,449	12,047	73,978	53,081	...	(h) 12,536	13,061	2,274	15,575	1,235	44,681	+ 8,400
Hull	(i)58,137	12,634	31,909	11,622	114,302	48,728	...	16,578	13,883	576	3,117	...	34,154	+ 14,574
Leeds	115,601	40,347	43,609	28,577	228,134	205,805	7,837	47,174	57,773	7,356	11,928	(i) 7,844	132,075	+ 81,567
Leicester	59,052	11,397	22,836	25,322	118,607	51,628	1,660	24,218	13,764	2,801	10,741	1,284	52,808	+ 480
London	H. 4,737 E.793,481	1,859 (r) 276,574	3,878 364,064	(m) 5,854 250,124	16,328 1,684,243	def. 5,527 704,803	... 47,425	330,301	405,605	32,102	1,541	(l) 15,851	785,400	− 33,172
N'castle-on-Tyne	71,892	25,519	27,150	22,991	147,552	113,649	4,086	(h) 31,257	41,450	3,618	...	2,805	79,130	+ 38,605
Northampton	8,428	3,187	3,103	6,136	20,854	10,455	473	(h) 3,900	4,624	441	90	(b) 1,221	10,276	+ 652
Portsmouth	31,414	(i)13,293	8,371	5,580	58,658	65,333	(a) 11,483	21,643	18,455	1,941	11,677	532	54,248	+ 22,568
Preston	12,350	4,989	9,252	2,995	29,586	16,360	...	3,625	5,038	...	...	1,356	10,019	+ 6,341
Reading	8,324	(i)4,356	4,313	3,643	20,654	16,028	11	6,709	5,062	263	...	...	12,034	+ 4,005
Sheffield	120,296	(i)31,784	45,385	49,365	246,830	147,701	2,056	31,747	42,504	5,567	30,017	8,014	117,849	+ 31,908
Wellington, N.Z.	57,973	7,775	21,918	17,947	105,613	52,644	2,091	19,865	4,757	...	14,682	...	39,304	+ 15,431

(a) Includes £10,703 balance forward from previous year. (b) Includes £152 loss on omnibus account less profit on parcel service. (c) Includes £1,611 insurance fund. (d) Includes reserve. (e) Includes rents for leased lines. (f) Rent of leased lines. (g) Rent of lines and deficit on motor omnibus account. (h) Including income tax. (i) Includes Army Service Allowance. (j) Includes £692 deficit on railless traction. (k) Includes rents of lines. (l) Including loss on horse traction. (m) Horsing expenses. (n) Transferred to motor omnibus capital account. (o) Includes £1,337 through-running contributions. (p) Includes £407 horse account. (q) Includes National Insurance. (r) Including special charges. (s) Includes £2,584 through-running contributions to L.C.C. (t) Includes balance forward from previous year. (u) From borough fund. (w) Amount apportioned to leased lines. (x) Includes £1,554 profit on motor char-a-banc. (y) Parliamentary Expenses. (z) Includes £6,519 rent of leased lines. * Includes £1,913 spent on renewals. † Under a resolution of the Council, the allowances to employees serving with the Forces, amounting to £6,031, are defrayed out of rates and therefore not included in these accounts. ‡ £2,950 profit from 3 months' working.

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COMPARATIVE ELECTRIC TRAMWAY ACCOUNTS

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Appropriation of Net Surplus.			Receipts per Car Mile.		Operating Expenses per Car Mile.					Per-centage of Operating Expenses to Total Revenue.	Average Operating Expenses per Car Mile (excludi'g Power Cost).	Board of Trade Units.		
	Carried Forward.	Reserve.	Contribution to Rates or Municip'l Funds.	Average Total per Car Mile.	Average Traffic per Car Mile.	Traffic.	General.	Repairs and Maintenance.	Power. (Price paid)	Total.			Units.	Cost per Unit.	Units used per car mile.
				d.	d.	d.	d.	d.	d.	d.	%	d.		d.	
Aberdeen ...	...	7,590	3,410	11·06	10·89	2·93	1·53	·99	1·03	6·48	58·54	5·45	2,317,204	·845	1·027
Accrington ...	...	...	1,568	12·64	12·49	3·17	1·18	·94	2·04	7·33	57·99	5·29	949,054	1·23	1·65
Ashton-u-Lyne	47	...	3,050	12·4197	12·0692	2·6622	·8695	1·5788	1·7434	6·8539	55·19	5·1105	640,413	1·25	1·38
Ayr...	...	1,141	...	10·45	9·88	2·26	1·12	1·02	1·32	5·75	55	4·42	421,844	1·39	·94
Birmingham ...	...	31,000	44,972	10·689	10·564	3·080	1·009	1·492	1·913	7·494	70	5·581	24,257,823	1·125	1·70
Blackburn ...	...	...	...	13·81	13·71	3·40	1·25	2·92	1·91	9·48	68·70	7·57	1,739,274	1·3	1·54
Blackpool ...	...	1,736	12,000	16·82	16·65	3·90	1·71	2·04	2·26	9·91	58·93	7·65	1,552,635	1·58	1·43
Bolton	58	...	17,000	11·758	11·656	2·498	·788	1·323	1·721	6·330	53·836	4·610	4,514,010	1·1	1·56
Bradford	...	14,610	10,000	12·425	11·816	3·457	1·041	2·450	2·027	8·975	74·60	6·948	12,272,121	1	1·926
Brighton	18	...	...	12·240	11·782	3·064	1·464	2·964	1·816	9·308	72·79	7·10	1,676,770	1·2	1·51
Burnley	...	...	1,664	11·450	11·259	3·085	1·108	1·334	2·620	8·147	71·16	5·53	3,621,567	1·15	2·20
Burton-on-Trent	1,163	...	...	9·02	8·28	2·97	·82	1·40	1·72	6·91	76·7	5·08	545,672	1·39	1·08
Bury	...	(k)1,000	5,000	10·26	10·22	2·399	·776	1·253	1·268	5·696	51·82	4·428	2,045,692	1·25	1·26
Chester	...	1,531	...	9·17	8·84	2·27	1·06	·83	1·45	5·61	61	4·17	378,158	1·33	1·08
Chesterfield ...	...	457	...	11·1	10·8	2·54	1·08	2·31	1·73	7·66	68·9	5·93	420,824	1·25	1·38
Colchester ...	...	...	...	9·942	9·668	2·194	·989	1·709	2·006	6·898	69·24	4·892	445,214	1·5	1·34
Croydon	...	190	...	7·593	7·526	2·683	·784	1·211	1·516	6·194	78·68	4·493	3,000,308	1·416	1·071
Darlington ...	...	...	...	8·230	8·063	2·676	·505	1·241	1·251	5·673	68·93	4·422	482,791	1	1·25
Darwen	...	...	...	14·02	13·13	3·65	1·03	2·93	2·38	9·99	71·15	7·61	485,033	1·312	1·812
Derby	(n) 75	...	...	E 10·358 H. 6·077	10·150 5·821	3·438 7·325	·577 ...	1·092 1·099	1·709 ...	6·816 8·424	65·8 138·6	5·107 ...	1,425,112 ...	1·45 ...	1·179 ...
Doncaster ...	...	654	...	10·52	10·37	2·24	·61	2·97	1·90	7·72	73·1	5·82	799,965	1·25	1·51
Dundee	...	61	1,000	11·802	11·465	3·082	1·278	1·288	1·847	7·495	63·5	5·648	2,564,659	1	1·847
East Ham ...	.	...	...	8·73	8·59	2·98	1·08	1·92	1·67	7·65	87·60	5·98	2,385,535	1·062	1·58
Exeter	...	1,724	...	9·456	9·404	2·628	·738	·797	2·059	6·222	65·8	4·163	565,247	1·625	1·27
Gloucester ...	...	...	...	6·84	6·41	2·78	·63	1·14	·71	5·26	77	4·55	470,336	1	·70
Halifax	...	(r) 7,483	(s)6,171	11·657	11·514	3·141	·812	1·393	2·225	7·571	65	5·35	4,607,293	1·125	1·98
Ilford	..	...	...	6·891	6·768	2·862	·688	1·048	1·278	5·877	80·9	4·598	1,079,384	1·065	1·175
Ilkeston	...	...	...	7·04	6·87	2·3	·8	1·3	1·4	5·8	83	4·4	372,200	1	1·54
Ipswich	...	...	...	8·705	8·52	3·290	·732	1·882	1·306	7·210	82·83	5·904	670,809	1·25	1·045
Keighley	...	...	.	9·064	8·754	2·664	·761	·890	1·595	5·910	65	4·315	254,636	1·5	1·05
Kilmarnock ...	...	...	...	7·539	7·326	2·57	·61	1·07	1·38	5·63	74·6	4·246	329,577	1·25	1·14
Kirkcaldy ...	33	...	...	9·085	8·864	2·574	·758	1·238	1·558	6·128	67·4	4·57	698,804	1	1·558
Lancaster ...	...	...	...	8·23	7·94	3·14	·71	1·16	2·19	7·20	88	5·02	225,094	1·7	1·29
Leith	...	...	...	9·54	9·24	2·46	·79	1·29	·99	5·53	57·98	4·54	939,737	1·001	·99
Leyton	...	...	...	9·355	9·151	(c) 2·959	1·140	1·815	1·710	7·624	81·338	5·914	3,043,900	1·019	1·678
Lincoln	52	...	...	10·59	10·40	2·34	1·06	1·56	1·41	6·37	60·2	4·96	173,895	1·25	1·128
Liverpool ...	...	..	100,000	12·25	12·02	3·380	1·227	1·460	2·171	8·238	65·6	6·067	26,007,694	1·14	1·9
Lowestoft ...	...	...	...	9·1	8·8	2·60	·5	1·2	1·8	6·1	67·64	4·3	318,601	1·75	1·03
Maidstone ...	...	...	...	8·51	8·06	2·02	·81	1·34	1·48	5·65	70·07	4·17	371,290	1·25	1·2
Manchester ...	...	...	100,000	11·300	11·123	3·420	1·473	1·069	1·608	7·570	63·47	5·962	29,922,197	1·029	1·562
Nelson	1,980	...	...	12·85	12·78	3·00	·81	1·81	2·51	8·13	63	5·62	255,621	2	1·26
Newport (Mon.)..	...	...	...	10·207	9·950	2·605	1·056	3·239	1·653	8·553	83·74	6·913	1,187,262	1·29	1·23
Nottingham ...	...	6,164	22,500	11·35	11·16	3·06	·93	1·10	1·94	7·03	62·78	5·09	5,806,688	1·25	1·53
Oldham	...	4,901	...	13·422	13·228	3·109	·992	2·570	2·376	9·047	67·40	6·671	3,291,607	1·5	1·585
Perth	...	...	...	9·39	8·51	3·08	·40	·77	1·46	5·71	60·79	4·25	295,846	1·25	1·17
Plymouth ..	..	...	4,037	12·066	11·450	2·42	1·11	1·29	2·298	7·12	60·83	4·82	1,159,069	1·66	1·38
Pontypridd ...	...		...	13·29	13·11	2·82	3·67	·74	1·84	9·07	68·26	7·23	627,593	1·25	1·47
Rawtenstall ...	...	...	...	10·11	9·699	2·40	·99	1·27	1·69	6·35	62·57	4·66	833,714	1·23	1·37
Rochdale... ...	4,284	...	...	11·292	11·134	2·611	·682	1·524	1·654	6·471	56·2	4·817	2,836,062	1·006	1·694
Rotherham ...	E. ... R.T...	...	1,500	12·37 ...	12·37 ...	3·11 ...	1·15 ...	1·65 ..	2·46 ...	8·37 ...	67·65 ...	5·91 ...	1,669,691 ...	1·25 ...	1·96 ...
Salford	...	...	22,000	10·501	10·499	3·059	·916	·970	1·936	6·881	65	4·945	9,812,392	1·23	1·606
Southampton ...	1,282	...	5,134	...	...	...	...	...	...	...	...	...	...	...	...
Southend-on-Sea	2,514	1,000	6,000	13·14	12·97	3·03	·85	1·33	2·33	7·54	57·35	5·21	848,538	1·75	1·33
Southport ...	...	..	...	9·763	9·528	2·462	1·101	1·607	1·554	6·725	68·8	5·171	468,554	1·5	1·011
South Shields ...	...	3,194	2,400	10·308	10·160	2·392	1·352	1·075	1·780	6·599	62·4	4·652	1,200,086	1·353	1·293
Stalybridge, &c.	...	...	...	8·084	8·056	2·755	1·079	1·600	1·453	6·887	83·15	5·269	1,803,063	·9	1·614
Stockport ...		250	12,250	10·958	10·745	2·388	·738	1·618	·961	5·705	47·94	4·744	...	...	...
Sunderland ...	..	...	5,000	12·210	12·148	3·198	·905	·786	1·820	6·709	54·75	4·8	1,802,694	1·5	1·21
Swindon	...	...	...	9·62	9·24	3·06	·89	1·65	1·99	7·59	79·29	5·60	277,568	1·6	1·24
Wallasey ...	...	4,500	(a) 8,000	12·048	11·896	3·499	1·252	1·160	2·018	7·929	65·8	5·911	1,851,649	1·4	1·44
Walsall	2,479		1,000	11·353	11·094	2·834	1·108	1·437	1·888	7·267	64·012	5·379	838,649	1·68	1·164
Walthamstow ..	...	...	...	8·75	8·66	3·02	·62	1·85	1·79	7·28	83·23	5·49	1,491,700	1·375	1·3
Warrington ...	739	..	2,500	12·521	12·246	3·161	·966	2·096	1·798	8·021	68·273	6·223	545,817	1·5	1·199
West Ham ...	...	273	...	9·713	9·427	3·359	1·314	2·127	1·239	8·039	78	6·41	6,306,731	·75	1·66
West Hartlepool	...	3,018	...	9·77	9·52	2·39	·79	1·49	1·13	5·80	59	4·67	680,972	·78	1·42
Wigan	902	...	...	12·415	12·077	2·791	·866	2·052	1·736	7·445	59·70	5·80	2,186,073	1·187	1·461
Wolverhampton	...	...	3,744	11·239	11·091	2·648	1·267	1·746	1·463	7·124	62·5	5·661	1,712,796	1	1·45
Yarmouth (Gt.)...	...	...	...	8·738	8·563	2·583	·616	1·016	1·649	5·864	68·48	4·215	758,296	1·56	1·052
York	...	2,524	...	9·08	8·86	2·95	·69	·66	1·78	6·08	67	4·30	1,009,827	1·25	1·43

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

									*				Works Cost.		
Belfast	...	...	12,185	10·08	9·93	2·83	·64	1·32	1·07	5·86	58·07	4·79	10,439,797	·658	1·39
Bexley	...	..	...	11·13	12·3	2·53	·85	2·82	·68	6·88	71·1	6·20	487,110	·827	1·66
Birkenhead ...	...	...	...	12·643	12·496	3·140	·991	2·170	1·336	7·637	60·33	6·30	2,672,599	·65	2·054
Bournemouth ..	...	2,000	...	12·83	12·76	2·95	1·02	1·26	(b) 1·99	7·22	56·21	5·23	3,245,277	·67	1·65
Cardiff	845	2,047	9,600	11·65	11·45	3·563	·900	1·468	·850	6·781	60	5·931	5,073,942	·488	1·71
Coventry ...	419	...	...	9·271	9·115	2·742	·953	1·694	·819	6·208	66·9	5·389	1,652,029	·544	1·47
Glasgow	...	...	12,951	10·674	10·612	3·426	1·922	1·432	·515	7·295	59·87	6·266	33,848,947	·366	1·40
Huddersfield ...	8,400	...	...	11·05	10·79	2·92	·70	1·78	1·04	6·44	58·22	5·40	5,398,258	·49	1·93
Hull	...	4,574	10,000	8·61	8·53	2·87	·66	1·68	·61	5·82	67·58	5·26	6,352,263	·44	1·40
Leeds	...	...	81,567	10·936	10·834	2·914	1·016	1·099	·720	5·749	52·57	5·029	18,862,847	·668	1·918
Leicester... ...	...	...	480	9·875	8·682	3·425	·661	1·325	1·469	6·880	69	5·411	7,540,856	·420	1·82
London	...	...	...	E. 9·77 H. 9·51	9·50 9·03	3·24 4·17	1·14 1·64	1·49 3·41	1·02 5·15	6·89 14·37	68·73 151·17	5·69 14·37	152,666,477 ...	·615 ...	2·60 ...
N'castle-on-Tyne	...	25,135	13,470	11·709	11·253	3·222	1·144	1·217	1·031	6·614	54·96	5·583	10,231,454	·421	1·922
Northampton ...	...	652	...	10·89	10·70	2·94	1·10	1·08	2·13	7·25	68	5·12	1,189,423	1·24	1·57
Portsmouth ...	6,568	(i) 6,000	10,000	12·201	11·997	3·092	1·308	·824	·549	5·773	45·88	5·050	3,272,089	·483	1·139
Preston	...	5,041	1,300	10·75	10·54	2·890	1·168	2·164	·700	6·922	64·40	6·222	1,765,250	·407	1·49
Reading	...	1,005	3,000	9·520	9·242	2·165	1·131	1·119	·945	5·360	54·55	4·248	1,180,507	·740	1·15
Sheffield	...	9,032	22.876	10·747	10·666	3·277	·866	1·236	1·345	6·724	61·116	5·379	18,329,775	646	1·979
Wellington, N.Z.	15,431	...	...	16·309	16·189	5·974	·801	2·259	1·850	10·884	65·86	9·034	4,769,149	·906	2·05

* The figures given under "Power" in Table II. include actual works costs only. H—Horse lines. E—Electric trolley system. (a)—Debit balance forward £426.
(b) Including current supplied by Bournemouth and Poole Supply Company. (c) Horse account ·054d. (f) Insurance fund. (i) Including Insurance. (k) Insurance.
(n) Remainder expended in paying capital expenditure not borrowed. (r) Renewals Fund. (s) Military Allowances, &c., £2,557. (t) Amounts for 15 months.

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COMPARATIVE ELECTRIC TRAMWAY ACCOUNTS

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Population Served.	Car Mileage.	Passengers Carried.	Traffic Records. Passengers Carried per Car Mile.	Average Fare per Passenger. d.	Average Journeys per Head of Popular'n per Annum.	Average Car Miles per Day per Car.	Traffic Revenue per Mile of Single Track. £	Average Traffic Revenue per Annum per Head of Popular'n Served.	Operating Expenses per Passenger. d.	Average Distance of 1d. Fare. Miles.	Average Fare Charged per Mile. d	Average Speed per Hour. Miles.	Average Total Car Hours per Day.	Average Number of Cars in Use Daily.	Number of Cars in Stock.
Aberdeen ...	165,000	1,909,009	24,048,816	12·59	·86	145·8	90	3,121	10/6	·514	1·861	·57	7·6	812	63	83
Accrington...	45,525	573,536	4,998,979	8·72	1·377	109·8	105	3,033	13/1	·84	1·07	·929	7·5	250	18	27
Ashton-u-L.	50,000	464,160	5,053,701	10·888	·648	173·09	106	2,851	9/4	·368	1·223	·81	8	190	12	25
Ayr	33,000	444,802	4,238,494	9·52	1·04	128	102	1,953	11/1	·606	1·25	·75	8	168	12	22
Birmingham	868,430	14,268,24	146,930,986	10·29	1·03	169	79·77	5,482	14 5	·904	2·	·427	7·87	10·16	500	550
Blackburn ...	200,000	1,121,769	12,223,569	10·89	1·28	61·12	105	2,528	6/6	·902	1·25	·76	7·50	434	31	61
Blackpool ...	67,500	1,085,685	13,624,514	12·55	1·32	201·8	103	4,370	22/4	·79	...	...	8	...	29	84
Bolton ...	221,000	2,886,180	31,370,166	10·86	1·066	141·49	124·07	2,920	12/8	·582	1·553	·633	7·25	980	70	112
Bradford ...	370,000	6,194,087	70,077,271	11·31	1·059	189	113	2,807	16/6	·84	1·66	·530	7·3	2,402·5	155	252
Brighton ...	133,936	1,108,382	11,837,828	11	1·10	88·38	76·08	3,165	8/1½	·83	1·27	·787	6·41	512	32	53
Burnley ...	175,000	1,644,712	15,867,699	9·65	1·16	96	120	3,544	8/10	·88	1·25	·83	7	798	42	67
Burton ...	48,000	439,248	3,339,184	7·60	1·058	70	...	1,782	6/3	·91	1·505	·58	7·5	...	...	20
Bury	128,202	1,613,387	15,513,264	9	1·07	121·47	99·73	1,904	10 9	·554	1·30	·77	8·54	...	...	54
Chester ...	39,028	347,260	3,217,899	9·26	·95	82·45	95	1,987	6/7	·606	1·27	·8	7	150·6	10·04	18
Chesterfield	50,000	304,376	2,950,774	9·7	1·1	76	122	2,668	5/5	·78	1·38	·75	7·33	126	7	17
Colchester ...	65,000	332,963	2,434,786	7·31	1·32	37·46	86·80	1,689	4/1	·94	·85	·96	6·77	147·14	10·51	18
Croydon ...	181,956	2,803,883	19,847,402	7·08	1·062	109·08	128	4,983	9/9	·850	2·15	·50	8·23	933·60	60	75
Darlington...	60,000	385,999	4,140,269	10·7	·752	69	96·1	1,460	4/4	·53	1·219	·45	6·66	151·25	11	18
Darwen ...	...	257,670	2,741,987	10·24	1·28	...	...	2,045	...	·97	...	...	...	...	...	...
Derby ...	124,000	E 1,208,880	12,136,148	10·039	1·011	97·88	...	2,398	8/3	·67	1·44	·75	6·375	...	...	50
		H. 17,710	110,231	6·224	·935			...	...	1·35	1	1	..	...	...	3
Doncaster ...	60,000	529,122	5,747,273	10·86	·955	95·79	93·9	1,798	7/7	·711	1·25	·76	7·5	239	18	32
Dundee ...	165,000	1,388,345	18,753,140	13·50	·851	113	...	2,345	8/	·544	2	·50	7·3	...	...	72
East Ham ...	145,000	1,510,251	16.671,505	11·04	·78	115	150	3,704	7/1	·69	1·635	·634	7	216	32	45
Exeter ...	48,660	446,336	4,320,459	9·68	·97	88·8	82·125	2,498	7/2	·642	1·1	·902	5·76	228	16	20
Gloucester ...	53,972	624,402	4,358,510	7	·92	81	90·60	1,113	6/2	·75	1·5	·65	7·08	250·8	19	30
Halifax ...	176,000	2,330,104	20,707,071	8·89	1·27	118	81·76	2,015	12/8	·852	1·553	·82	7·23	883·74	78	101
Ilford ...	84,000	899,515	8,036,552	9·70	·758	95·7	...	2,236	5/7	·62	1·543	·69	8	...	...	26
Ilkeston ...	32,000	241,548	1,746,382	7·2	·95	...	90	1,942	52/8	·8	1·50	·5	7	101	7	13
Ipswich ...	76,472	642,092	5,610,332	8·73	·975	73·4	64·4	1,532	6/	·82	1·53	·693	5·47	322·56	20·16	36
Keighley ...	43,000	242,500	3,099,272	12·8	·68	72·08	55·35	1,447	4/1	·462	2·22	·45	6·87	126	7	12
Kilmarnock	36,000	297,743	2,482,034	8·33	·875	68·94	93·12	1,632	5/-	·675	1·13	·86	7·22	109·14	8·76	14
Kirkcaldy ...	39,600	448,469	5,492,120	12·24	·723	138	49	1,882	8/4	·5	1·522	·64	7	158	17	22
Lancaster ...	41,786	176,752	1,603,321	9·17	·865	38·37	76	1,204	2/9	·785	1·71	·5	8	87·22	6·23	12
Leith ...	110,400	949,322	10,244,235	10·79	·86	92·8	125	2,031	6/8	·512	1·32	·72	8·3	314	21	37
Leyton ...	124,735	1,813,462	17,472,882	9·64	·950	140	120	3,820	11/1	·791	1·77	·95	8·25	14·5	40·0375	60
Lincoln ...	20,000	148,440	1,713,542	11·5	·89	85·67	59·3	2,169	6/5	·552	1·75	·428	7	72	4	8
Liverpool ...	840,000	13,657,888	145,656,374	10·67	1·127	173·40	89·09	5,516	16/3	·772	2·814	·39	7·75	5,040	420	596
Lowestoft ...	35,000	307,838	2,706,348	8	1·07	77·32	70·25	2,787	6/6	·703	1·5	·7	5·75	192	12	19
Maidstone ...	25,000	309,256	2,407,769	7·783	1·036	96·312	85	1,476	8/4	·725	1	1	6·8	133	12	19
Manchester	957,500	19,155,051	202,768,420	10·6	1·06	212	93·5	4,835	18/7	·717	2·514	...	7·75	7·2	561	683
Nelson ...	45,000	202,781	2,949,784	14·55	·88	65·55	92·59	2,796	4/9	·56	1	1	5·50	108	6	11
Newport ...	89,400	968,524	9,155,356	9·45	1·08	102·41	100	2,798	9/-	·904	1·164	·898	...	...	34	44
Nottingham	264,000	3,789,887	41,210,964	10·87	1·02	156	95·28	3,984	13/4	·646	1·75	·442	6·92	...	109	155
Oldham ...	180,000	2,077,104	22,773,108	10·963	1·19	126·52	121	3,136	12/8	·825	1·11	·884	7	846	47	92
Perth... ...	35,900	252,216	1,844,588	7·31	1·16	51	...	1,289	5/-	·78	...	...	...	...	...	...
Plymouth ...	112,000	838,142	9 333,087	11·13	1·027	83·33	...	2,666	7/2	·639	...	...	...	...	...	42
Pontypridd...	50,000	426,228	5,577,666	13·09	1	111	...	2,707	9/4	·69	...	...	...	...	...	...
Rawtenstall	40,000	605,485	4,869,792	8·04	1·21	122	111	1,540	12/3	·79	1·121	·88	8·50	247·5	15	24
Rochdale ...	130,000	1,772,546	14.286,607	8·06	1·387	109·90	110·30	2,085	11/11	·78	1·07	·90	7·33	660	44	69
Rotherham...	64,000	E 850,548	9,828,838	11·55	1·07	153·6	...	3,645	13/1	·72	...	...	...	...	...	...
	...	RT ...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Salford ...	350,000	6,235,278	53,124,546	8·52	1·227	151	108	3,646	15/7	·88	2·20	·46	7·916	2,054	158	200
Southampt'n	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Southend ...	78,000	637,366	7,581,104	11·89	1·09	97·2	87	4,708	8/10	·634	1·41	·76	6·5	357	21	31
Southport ...	31,312	463,262	4,663,579	10·067	·94	148·62	98	1,710	11/5	·677	1·6	·62	6·65	825	15	26
So'th Shields	110,600	927,728	10,479,421	11·296	·899	91	126	3,826	7/1	·58	3·1	·38	7·71	285	20	40
Stalybridge	94,091	1,116,936	8,406,915	7·706	1·06	89·3	...	1,353	8/	·905	1·22	·72	6·8	...	...	60
Stockport	120,000	1,490,116	...	...	...	...	...	2,356	11/2	...	...	..	..	...	...	...
Sunderland	170,000	1,486,201	18,619.364	13·2	·97	109·5	78·3	3,696	8/10	·536	1·34	·68	7	688	43	70
Swindon ...	53,000	223,383	2,392,470	10·71	·859	45·14	75	1,955	3/4	·709	1·2	·85	6	...	...	12
Wallasey ...	87,000	1,284,938	13,555,876	10·54	1·15	153·51	99·2	3,190	14/8	·75	1·89	·54	7	388·53	35·5	67
Walsall ...	100,000	720,634	6,752,727	9·371	1·184	68	94	1,905	6/7	·775	1·24	·79	7	315	21	39
Walth'mst'w	130,000	1,146,743	13,499,838	11·77	·732	103	104	3,089	6/4	·618	1·18	·86	7·6	430	37	38
Warrington	86,000	455,304	6,134,545	13·473	·909	71·332	102·423	2,406	5/5	·59	1·246	·803	6·401	194·86	12·179	21
West Ham	296,570	3,760,361	42,667,561	11·35	·852	144	90	5,041	10/-	·67	1·85	·50	7·66	1,195·75	93	118
W. Hartlep'l	90,000	479,382	4,261,917	8·89	1·07	47	94	2,163	4/3	·65	1·262	·94	7	203	14	26
Wigan ...	200,000	1,495,786	13.811,709	9·23	1·344	69	97·57	2,427	7/6	·802	1·15	·88	7·4	567	42	73
Wolverh'ton	135,000	1,181,309	12,236,785	10·359	1·06	90·64	89	2,539	8/1	·687	1·25	·879	6·88	651·6	36·2	52
Yarmouth ...	56,000	720,702	4,930,728	6·84	1·231	88·05	79	1,746	9/2	·857	1·25	·76	7	375	25	35
York	82,600	707,370	5,946,843	8·41	1·05	72	108	2,193	6/2	·73	1·33	·789	8	270	18	31

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast ...	390,000	6,432,600	62,340,269	9·74	1·02	159	128	2,689	13/8	·60	1·96	·43	8·75	2,014	241	290
Bexley	16,500	316,970	2,270,070	7·16	1·55	133	126	2,922	19/10	1·24	1·59	·63	9·5	179	11	16
Birkenhead	135,740	1,300,717	15,167,958	11·66	1·071	111·74	69·98	2,811	9/11	·71	1·39	·66	6·84	520·61	50·94	65
Bournem'uth	120,000	1,962,352	17,182,844	8·76	1·46	143	95	3,505	17/5	·824	1·19	·87	6·8	1,140	60	81
Cardiff ...	182,729	2,966,230	31,122,962	10·49	1·09	170	98·5	4,447	15/6	·65	1·44	·736	7·5	1,264	79	130
Coventry ...	135,000	1,125,705	8,407,719	7·5	1·22	62	66	2,714	6/4	·831	1·18	·866	6·4	476	40	46
Glasgow	1,150,000	24,214,460	336,260.758	13·887	·764	292·4	105·61	5,404	18/7	·488	2·31	·44	8·11	8,974·78	628·20	856
Huddersfield	160,000	(a) 2,797,276	23,933,065	8·69	1·24	159	84	3,556	15/6	·73	1·34	·69	7·72	1,012·16	63·26	106
Hull ...	291,118	4,851,145	52,087,770	11·44	·745	178·92	123·43	4,879	11/1	·52	2·75	·364	9	1,565·60	97·85	180
Leeds ...	525,000	9,522,737	95,633,268	10·04	1·075	182	115·43	3,747	16/4	(b) ·884	1·93	·539	7·54	3,465	230	345
Leicester ...	232,644	4,137,262	37,914,773	9·146	·947	163	108·35	4,045	12/10	·751	2·18	·45	8	1,451	...	160
London ...	...	E58,706,161	547,253,352	9·32	1·02	...	117·07	8,465	...	·73	...	...	8·95	17,972	1,374	1,720
		H 272,631	3,244,661	11·90	·76		77·12	1,045	...	1·21	...	...	5·85	131·80	10	37
Newcastle ...	300,000	5,353,875	57,840,666	10·81	1·071	193	100	3,992	16/9	·612	1·58	·633	7·5	...	133	200
Northampt'n	91,500	690,177	8,295,941	12·02	·89	90·66	...	2,470	6/8	·603	1·34	·7	...	...	...	33
Portsmouth	246,000	2,438,621	27,554,194	11·299	1·061	112·01	90·29	3,535	9/1	·495	1·66	·62	7	1,065	74	100
Preston ...	120,000	1,025,738	10,340,688	10·08	1·04	86·17	132	2,652	7/7	·764	1·01	·95	7·36	404·7	21·3	33
Reading ...	76,500	924,696	8,881,097	9·6	·96	116	114	2,704	9·4	·54	1·59	·68	7·5	336	25	36
Sheffield	485,228	8,810,252	107,023,195	12·147	·878	220	108·86	4,950	16 2	·553	2·917	·371	...	3,215·05	221·728	339
Wellington	70,000	2,328,849	24,565,376	11·28	1·43	359	85	4,708	44/10	1·031	1·125	89	7·59	840	75	92

E—Electric trolley system. H—Horse lines. (a) Including 9,467 miles coal haulage. (b) Total expenses per passenger.

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NEW CONTRACTS AND ORDERS.

The General Post Office have placed a contract for Royal Ediswan drawn-wire lamps.

Herbert Morris, Limited, of Loughborough, have supplied an overhead crane to Luton Council.

Sydney Council have placed orders with the General Electric Company, London, for 12,500 vacuum lamps.

W. T. Glover and Company, Limited, have received a contract from Sheffield Council for the supply of cables.

Hadfields Limited, Sheffield, have received a contract from Lowestoft Council for the supply of twelve rolled steel car axles.

The British Westinghouse Company have obtained a contract to supply a rotary converter, at £1,580, to Wednesbury Council.

Scottish Motor Traction Company, Limited, of Edinburgh, have secured a contract for the conveyance of mails for H.M. Post Office.

Great Yarmouth Council have accepted the offer of the Stern, Sonneborn Oil Company, Limited, for the supply of motor axle grease and graphite grease.

Messrs. J. A. Panton and Company, Liverpool, have received an order from the Metropolitan Railway Company for 5,000 brake blocks and collector slippers.

Messrs. Spurrier, Glazebrook and Company have received an order for the supply of lubricating oils to the Liverpool Electricity Supply Department for seven months.

Dick, Kerr and Company, Limited, have been notified of the decision of Reading Council to place an urgent order with them for new motors and controllers for the tramcars.

Keighley Council have been recommended by the Tramways Committee to purchase a press for affixing tires to the wheels of railless trolley cars at an estimated cost of £130.

Melbourne Council have accepted the tender of the British Westinghouse Electric and Manufacturing Company, Limited, for the supply of a 1,500 KW. rotary converter with transformer.

Messrs. Bellis and Morcom, Limited, of Birmingham, have received a contract for the supply and fitting of new valves for the intermediate cylinders of engines of a 500 KW. set at Stretford electricity works.

Winter Hats for Women Conductors. Sheffield Tramways Committee have placed a contract with Charles Macintosh and Company, Limited, Manchester, for winter hats, at 2s. 3½d. each, for women conductors.

Great Yarmouth Council have accepted the following contracts:—Cleeves and Company, London, 1,000 tons ½-in. slack and 500 tons hard steam coal; Hazel and Company, overcoats 29s. each, inspectors' coats 40s.

Coventry Electricity Committee has accepted the tender of the British Thomson-Houston Company, Limited, for a 6,000 KW. set, and that of Messrs. Babcock and Wilcox, Limited, for four boilers for the electricity works.

Durban Council have placed a contract with T. Barlow and Sons, for the supply and erection of condensing plant, and with Messrs. Runnert and Lenz, Johannesburg, for the supply and erection of a Babcock and Wilcox boiler.

Wellington (N.Z.) Corporation have awarded to the British General Electric Company a contract for the supply of switch panels, etc., and to P. R. Baillie and Company for the supply of 120 miles of twin twisted rubber insulated wire.

Salford Council have accepted the tender of J. Gerrard and Son, Limited, for alterations to buildings and construction of foundations at the generating station. The work is necessitated by the decision to instal a 5,000 KW. turbo-alternator.

Sunderland Council have placed contracts as subjoined:—Extra high-tension switch gear and meters, Ferranti, Limited; cable, B.I. and Helsby Cables, Limited; transformer oil, E. C. Rees; cable, I.R., G.P. and Telegraph Works.

West Hartlepool Council have accepted an offer made by the Railway Passengers' Assurance Association to insure against third party risks. The Tramways Committee have now called for offers for the insurance of the workmen of the department.

Hawthorn Tramways.—The tender of H. Teesdale Smith has been accepted by the Hawthorn Tramways Trust for the construction of the permanent way for the electric tramway from Melbourne to Burwood. The amount of the tender is £55,064 18s. 6d.

Paris, Lyons, and Mediterranean Railways have purchased 400,000 tons of smalls on a 9 per cent. cash basis at Cardiff. It is understood that the price paid for the coal itself is from 15s. to 16s. The company have also purchased 105,000 tons of patent fuel.

Glasgow Tramways Committee have placed the following contracts:—Storage battery for Kinning Park sub-station, Chloride Electrical Storage Company, Limited; motor-generator and switchboard, Mavor and Coulson, Limited; vulcanised rubber cables, Pirelli-General Cable Works, Limited.

The General Electric Company, Limited, have received, for the seventh time, the G.P.O. (six-monthly) contract for the supply of Osram drawn-wire lamps. The company have also received contracts for the supply of many thousands of Osram and Robertson lamps to the Admiralty and War Office.

Dartford Electricity Committee have recommended the acceptance of the following tenders for coal:—J. Waddell and Sons, Limited, 500 tons Yorkshire Main, at 24s. 6d. per ton; Myers, Rose and Company, Limited, 500 tons Yorkshire nutty slack, at 21s. 9d. per ton; 500 tons Notts Mansfield slack, at 20s. 9d. per ton.

New Tramways in Spain.—Don Juan Gari has been awarded a contract for the construction of an electric tramway between Mougat and Tiana, Barcelona. The Compañia Vizcina de Electricidad have received a contract for the construction and working of an electric tramway from Deusto to Ibarreeolanda, Vizcaya.

Lower Coal Prices at Glasgow.—In May last 17s. 10d. per ton was asked for the coal desired by Glasgow Tramways Committee. As a protest against the price the committee declined to purchase. They have now effected contracts which show an average saving of 2s. per ton. The department consumes 50,000 tons per annum.

Melbourne Council have placed contracts for the supply of electrical stores during the year ending June 30 next with W. T. Henley's Telegraph Works Company, Limited, Edison and Swan United Electric Light Company, Limited, British Insulated and Helsby Cables, Limited, and British General Electric Company, Limited.

Stockport Tramways Committee has accepted the following tenders:—Hadfields, Limited, one ton of mild steel fishbolts and nuts (£21 10s.); J. C. Arnfield and Company, 20 gallons of shellac varnish; John Baker and Company (Rotherham), Limited, wheels and axles; British Thomson-Houston Company, Limited, turned bolts and axle caps.

Cory Brothers, Limited, Cardiff, have received a contract for a six months' supply of Russell's new black vein washed beans coal at 25s. 6d. per ton, delivered to Taunton Council. Six months ago the price paid for coal was 17s. 4d., and the Council have now increased the charge for power by 15 per cent. The Council contemplate shortly to make another contract for coal to cover a longer period.

London County Council have accepted the tender of Mr. W. H. Wheeler, at £987, for repairs to the carriageway of Blackwall Tunnel. Tramways terminate at each end of this road under the Thames, but single-deck omnibuses, privately owned, use the tunnel. The Council have also accepted tenders for the supply on hire of drivers, horses, carts, vans, and trolleys for the southern depots of the tramways department.

The Electricity Committee have placed contracts as subjoined for the supply of coal during the period ending July 31 next:—Clifton and Kersley Coal Company, Limited, Pendleton, 16,000 tons best washed slack, in boxes in boats, 17s. per ton; A. Knowles and Sons, Limited, Pendlebury, 8,000 tons best washed slack, in boxes in boats, 17s. per ton; Earl of Ellesmere, Manchester, 6,000 tons best washed slack in carts, 17s. 6d. per ton.

The Victorian Railway Commissioners have accepted the following tenders:—Construction of sub-station at North Fitzroy, Swanson Brothers, £15,740; two air-compressors, £335 each, Belliss and Morcom, Limited; high and low tension cable, British Insulated and Helsby Cables, Limited; two motor-driven air-compressors, with spare parts, for Jolimont car shop, and four motor-driven air-compressors (including motors) for the Ballarat and Bendigo workshops, £3,462, Belliss and Morcom, Limited. The Commissioners have also placed the following contracts:—British Insulated and Helsby Cables, overhead equipment for St. Kilda, Brighton Street, tramways; R. W. Cameron and Company, tramway rails.

Government Contracts.—The following contracts were let during the month of August:—

Motor bodies, D. Napier and Son, New Burlington Street, W.; motor lorry bodies, E. W. Hora, Limited, 36, Peckham Road, S.E.; motor cars, Wolseley Motors, Limited, Birmingham; cars (side, motor), Phelon and Moore, Limited, Cleckheaton; cable and wire (electric), Callender's Cable and Construction Company, Limited, Lancashire; General Electric Company, Limited, Birmingham; Liverpool Electric Cable Company.

Electric lamps, General Electric Company, Limited; Siemens Bros.' Dynamo Works, Limited; locomotives and parts, R. Hudson, Limited, Gildersome Foundry, Leeds; Manning, Wardle and Company, Limited, Leeds; lorries (motor and parts), Lancashire and Yorkshire Railway, Manchester; Leyland Motors (1914), Limited, Leyland, Lancashire; Smith, Parfrey and Company, Limited, Hammersmith, W.; Tilling-Stevens, Limited, Maidstone; motors and dynamos, Electric Construction Company, Limited, Wolverhampton; Electric and Ordnance Accessories Company, Aston; Mawdsleys, Limited, Dursley; motor rollers, Barford and Perkins Peterborough Wallis and Steevens, Basingstoke.

Petrograd Tramways Extension.—Petrograd Town Council has allocated 200,000 roubles for preliminary work regarding the construction of fresh tramway lines over a number of sections already decided on.

A Check to London Police Opposition.—A Select Committee of the House of Lords overruled the objections of the Metropolitan Police to two tramways proposals of the London County Council on September 30. In regard to a new tramway in Hackney, Scotland Yard made demands for widenings that would entail an outlay of £150,000, and they expressed the view that tramways made the regulation of traffic more difficult. To the proposed reconstruction of the horse lines in Bermondsey the police objected on the ground of congestion in one of the streets which was used as a costermongers' market. They also asked for the line to be doubled, thus trebling the cost. The Committee passed both projects, and the Bill was reported for third reading.

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FINANCIAL REPORTS AND MEETINGS.

Madras Electric Tramways (1904), Limited.—Interim dividend at the rate of 6 per cent. on the preference shares.

Winnipeg Electric Railway Company.—Dividend for the quarter ending September 30 at the rate of 10 per cent. per annum.

Albion Motor Car Company.—Interim dividend at the rate of 5 per cent. per annum on the ordinary shares for the half-year.

Northern General Transport.—Interim dividend at the rate of 5 per cent. per annum, less income tax, on the ordinary shares for the half-year.

Brazilian Traction, Light and Power Company.—A quarterly dividend of 1¼ per cent. on the fully paid up cumulative preference shares is payable on October 1.

Melbourne Tramway and Omnibus.—The directors have declared a dividend of 6d. per share for the quarter ending September 30, also bonus of like amount, making together 1s. per share.

Southampton Corporation Tramways.—The figures in the appended table are from the reports for the past two years :—

	1914-15.	1913-14.	Inc. or Dec.
Capital expenditure	£259,832	£258,299	+ £1,533
Loans outstanding	£158,729	£164,454	− £5,725
Total track mileage	18 miles	18 miles	—
Number of cars in stock	73	70	+ 3
Traffic revenue	£68,042	£67,672	+ £370
Total revenue	£71,037	£70,598	+ £439
Working expenses	£50,306	£46,521	+ £3,785
Gross balance	£20,731	£24,077	− £3,346
Net profit	£6,416	£8,937	− £2,521
Passengers carried	13,265,715	13,162,224	+ 103,491
Fare per passenger	1·231d.	1·23d	—
Car mileage	1,703,032	1,543,041	+ 159,991
Power cost per car mile	1·768d.	1·915d.	− ·147d.
Traffic receipts per car mile	9·59d.	10·52d.	− ·93d.
Expenses per car mile	7·09d.	7·23d.	− ·14d.

Bradford Corporation Tramways.—The chief items in the annual statement of accounts presented to the City Council by Mr. C. J. Spencer, general manager of the tramways department, are given below, together with the corresponding figures for the preceding year :—

	1914-15.	1913-14.	Inc. or Dec.
Capital expenditure	£1,043,054	£1,040,118	+ £2,936
Loans outstanding	£634,618	£653,504	− £18,886
Total track mileage	108m. 53ch.	106m. 29ch.	+ 2m. 24ch.
Number of cars in stock	252	245	+ 7
Traffic revenue	£305,005	£297,019	+ £7,986
Total revenue	£329,888	£317,133	− £12,755
Working expenses	£246,096	£231,151	− £14,945
Gross balance	£83,792	£85,982	− £2,190
Net profit	£32,442	£29,447	+ £2,995
Passengers carried	70,077,271	67,675,166	+ 2,402,106
Fare per passenger	1·059d.	1·058d.	+ ·001d.
Car mileage	6,194,057	6,206,239	− 12,182
Units per car mile	1·900	1·894	+ ·016.
Power cost per car mile	2·027d.	1·948d.	+ ·079d.
Traffic receipts per track mile... ...	£2,807	£2,793	+ £114
Traffic receipts per car mile	11·816d.	11·486d.	+ ·330d.
Expenses per car mile	8·774d.	8·376d.	+ ·398d.
Ratio of working expenses	74·600%	73·138%	+ 1·462

Croydon Corporation Tramways.—The results for 1914-15 show a net balance of £190, which was placed to the renewals fund. From April 1 to July 31 the receipts increased by £2,382, but the war resulted in a considerable falling off in the traffic. But for the national crisis the general manager considered that the percentage of increase earned during the first four months of the year would have been maintained, thus giving a net increase for the year of approximately £6,800. Owing to the war there had been a decrease in omnibus competition. There is a renewals fund of £41,643, and £15,800 has been applied to the relief of the rates. The undertaking was acquired in 1906.

	1914-15.	1913 14.	Inc. or Dec.
Capital expenditure	£287,396	£284,847	+ £1,917
Loan outstanding	£222,223	£229,300	− £7,415
Total track mileage	17 m. 50 ch.	17 m. 50 ch.	—
Number of cars in stock	75	75	—
Traffic revenue	£87,833	£84,926	+ £2,907
Total revenue	£89,363	£87,026	+ £2,337
Working expenses	£70,307	£69,743	+ £564
Gross balance	£17,081	£17,947	− £866
Net profit	£191	£1,362	− £1,171
Passengers carried	19,847,402	19,227,878	+ 619,524
Fare per passenger	1·062d.	1·060d.	+ ·002d.
Car mileage	2,800,672	2,798,175	+ 2,497
Units per car mile	1·071	1·027	+ ·044
Power cost per car mile	1·518d.	1·561d.	− ·043d.
Traffic receipts per car mile	7·53d.	7·28d.	+ ·25d.
Expenses per car mile	6·025d.	5·982d.	+ ·043d.
Ratio of working expenses	78·68	79·53	− ·85

Mr. T. B. Goodyer, the general manager, was congratulated upon the report by Alderman G. J. Allen, the chairman of the Tramways Committee, at the meeting of the Council at which it was presented. There was no doubt that the undertaking was sound. Repairs had practically been made out of revenue.

Record Revenue at South Shields.—In presenting to South Shields Corporation the annual report on the tramways undertaking (which was signed by Mr. W. T. Robson, now of Southampton), Alderman W. G. Wylie, chairman of the Tramways Committee, said the income totalled £39,000, or £1,500 more than had been received before. The net surplus was £5,900, as against £7,100. The decrease was made up by heavier rates and taxes, general expenses, and repairs, the power expenses of the electric omnibuses, and war allowances. The reserve fund had been brought up to £30,800, and he hoped that when the time came to use that money it would be wisely utilised to further extend the system. Nine years' working had now been completed by the undertaking, and it was in a sound financial position.

United Electric Car Company, Limited.—Mr. R. B. Barningham, presiding at the annual meeting at Preston on September 15, said that, owing to the war, the average number of men employed was only 379, against 491 normally, 35 per cent. of their employees having joined the Army. This was a serious matter in the item of standing charges alone. The war caused almost an entire cessation of their ordinary trade. Tramway undertakings, almost without exception, refused to place orders for new cars. This was also the case in most of their foreign trade. They had secured a certain amount of Government work, chiefly in the shape of limbers, general service and pontoon wagons, cartridge boxes, and pontoon boats. There was, however, very keen competition, and prices were cut very fine. The result of the year's working was a net profit of £8,552, a decrease of £7,500. The meeting authorised the payment of a dividend on the preference shares amounting to £3,000. Mr. Lincoln Chandler and Mr. H. M. Malcolm were re-elected directors. The report showed that after charging £5,332 for depreciation (including £4,500 added to reserve), the profit for the year ended June 30 was £8,553, and with £2,154 from last year, the total was £10,707. Deducting the preference dividend for the six months ended December 31, 1914 (£3,000), the available balance was £7,707. The directors recommended payment of the preference dividend for the half-year ending June 30 (£3,000), and the carrying forward of £4,707.

PERSONAL.

Messrs. George Balfour and Hynd have been re-elected directors of Dundee, Broughty Ferry, and District Tramways Company.

Mr. J. W. Womar, chief clerk to West Hartlepool Corporation Tramways Department, has been granted an increase in his salary.

Alderman S. W. Meyer, chairman of York Tramways Committee, has declined election to the Lord Mayoralty of York on account of the health of his wife.

Sergeant M. Rathbone, formerly manager of the Oldham, Ashton, and Hyde Electric Tramways Company, is serving in the war area with the King's Royal Rifles.

Alderman J. H. C. Corke, chairman of Portsmouth Tramway Committee, has again been selected as Mayor of Portsmouth. This will be his fourth year of office.

Mr. C. W. Shepherd, general manager of Edinburgh Tramways Company, is showing his interest in the wounded soldiers in the Scottish capital by entertaining them at theatres.

Sergeant A. E. Irving, of Burnley Corporation Tramways, who recently won the Distinguished Conduct Medal in France, has been awarded the Medal of St. George by the Czar of Russia.

Mr. James Sellar has been appointed a director of the Aberdeen Suburban Tramways Company. Mr. Sellar was formerly manager of Tanjong Pagar Dock Company, Singapore, in which capacity he for a time managed the Singapore Tramways.

Mr. A. E. Wray, who was recently appointed engineer and manager to Luton Tramways Company, has undertaken to confer with the borough engineer in order to remedy complaints respecting the track, time clocks, and boxes. Mr. Wray has informed the Council that he is endeavouring to improve the service generally.

Mr. H. S. Ellis, borough electrical engineer, South Shields, was referred to at the September meeting of the Council by Alderman Rennoldson, chairman of the Electricity Committee, as having with his staff worked the undertaking in an economical and efficient manner. The Alderman added that this was very gratifying, as the war had considerably increased the expenditure. The surplus, however, was about the same as in the previous year.

Mr. R. Simpson, general manager, Tynemouth and District Electric Traction Company, has been appointed engineering manager of the Worcester Electric Tramways Company, to succeed Mr. J. R. Groves upon his removal to Gravesend. On the occasion of a presentation to him, Mr. Groves informed the employees that Mr. Built had been given charge of the office and staff, while Mr. Smith would supervise the mechanical staff. Mr. Groves expressed the hope that the employees would be as loyal to his successors as they had been to him.

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Bristol Electrical Appointments.—The Corporation on September 14 adopted the Electrical Committee's recommendation that the vacancy caused by the appointment of Mr. A. E. Wilson to the position of electrical engineer to the chief engineer of the Southern Command be filled by the promotion of Mr. A. J. Newman, at a salary of £350, rising to £400.

Mr. J. R. Groves, manager of Worcester and District Electric Traction Company, has been appointed general manager of Gravesend and Northfleet Electric Tramways Company, including the petrol motor fleet. Mr. Groves was at Worcester for seven years, and there built up a considerable automobile business. Last year the vehicles were impressed for war purposes, and the motor traffic is being carried on by the Birmingham Company until new vehicles can be acquired. Mr. Groves, thirty years ago, served first with Edinburgh Tramways Company, and afterwards at Cardiff. In 1901 he became manager at Yarmouth, and at Croydon. Afterwards he served at Peterborough. Presentations were made on September 18 to Mr. and Mrs. Groves by the Worcester employees, the gifts including an album containing the names of the donors. Mr. Built, in making the presentations, referred to the progress of the company, and said that Mr. Groves' departure would be a loss to the town and the tramway employees. In reply, Mr. Groves said he was glad to see so many of the original staff still there. He complimented the lady conductors on the way in which they carried out their duties.

Mr. W. Thomas, late chief inspector of West Ham Corporation Tramways, whose death was announced on September 17, drove the first electric car at the opening of the undertaking. He was formerly with Liverpool Corporation Tramways.

Sergeant-Major C. Morrison, 10th Battalion, Gordon Highlanders, who in September was killed in action, had for eight years served as inspector of Aberdeen Corporation Tramways. He entered the Corporation's employ fifteen years ago, and rejoined the army on the outbreak of the war. During his previous service he went through the Chitral and South African campaigns.

Lieutenant C. H. N. Scholey, 9th Battalion Rifle Brigade, who was killed during the British advance in France on September 26, was the only child of Mr. and Mrs. H. Scholey, of Bedford Park, W., and 56, Victoria Street, S.W. The gallant officer, who was 23 years of age, was at Clare College, Cambridge University, when the war broke out, and in the following month he received a commission in the Rifle Brigade. In the army he showed as much promise of a notable career as he did in civil life, and in less than a year he was given command of his company.

Mr. John Gardner, manager of Chester Corporation Tramways, died on September 16, after an illness of three weeks, due to ptomaine poisoning. Originally Mr. Gardner was with the Liverpool Tramways Company, and thirty years ago he went to Chester, where he became manager of the horse tramways. His services were retained by the Corporation when the undertaking was purchased and electrified in 1903. Mr. Gardner, who was 64 years of age, was greatly esteemed for his zealous work and amiable disposition. He was formerly president of Chester Caledonian Association. At the funeral on September 20 there was a large attendance of members and officers of the Corporation and of the local Freemasons, while Mr. R. Roulston represented Mr. C. W. Mallins, general manager of Liverpool Corporation Tramways. Local tramways employees acted as bearers.

RAILWAY OFFICERS AND STAFF.

Mr. Cecil Partridge, late manager of the Central London Railway, is the general manager of the Metropolitan Munitions Committee, Alexandra House, Kingsway.

Mr. R. F. Castleman, the L. & N.W. Railway district goods manager for Crewe, who has retired, is succeeded by Mr. F. P. Kinsman, the district traffic superintendent at Shrewsbury.

Lieutenant S. E. Fay is one of the officers of the 11th Company of the Royal Engineers, who are now serving in France. This unit is composed of officers and employees of the Great Central Railway Company, and is 250 strong.

Mr. Philip Laing, who will be remembered as the locomotive inspector who had an almost miraculous escape from death in the Colchester accident on the Great Eastern Railway, has obtained a commission as Probationary Flight Sub-Lieutenant in the Balloon Section of the Royal Naval Air Service.

Mr. Vincent Raven, chief mechanical engineer, North Eastern Railway, who was recently appointed to the Ministry of Munitions, on September 20 took charge for the time being as chief superintendent of the ordnance factories at Woolwich Arsenal. Mr. Raven succeeded Sir F. Donaldson, who has become adviser at the Ministry of Munitions. Mr. Raven recently asked Darlington Council to accept his resignation from the Corporation. The Mayor observed that it would be a calamity to lose the services of Mr. Raven, and the Council resolved that his place should not be filled.

TRAMWAY AND LIGHT RAILWAY NOTES.

BIRMINGHAM.

PRESSING NEED FOR MOTORMEN.

The increasing requirements of the munition workers' traffic has caused great pressure upon the tramways department, weekdays and Sundays. To requests for additional cars the management have had to reply that the services cannot be increased unless more motormen can be secured. As it is, the number of motormen is decreasing owing to enlistments and munition work, and in a short time the services may have to be restricted. This has already been done on routes where there are no munition workers to be conveyed. A large number of cars and motor omnibuses are standing idle for want of drivers. More than 1,100 of the car hands have enlisted and many more have gone to munition factories. Nearly 700 of the former number were motormen, and their absence has brought about a reduction of nearly 10 per cent. in the ordinary services.

BRADFORD.

SUCCESSFUL ORGANISATION.—RESTRICTIONS IN FREE RIDES.—PARCELS TRAFFIC.—FERRO-CONCRETE TRACK FOUNDATION.

Referring in his annual report to 94 reservists being recalled to the colours in a few days from the opening of the war, Mr. C. J. Spencer, general manager, Bradford Corporation Tramways, says: —"Due to the system that had been in operation for some years, there were available a considerable number of conductors who were trained drivers, and they stepped into the positions of those who had been called away. The conductors in turn were recruited from the ranks of the cleaners, so that the various difficulties were met by an existing organisation, which was very gratifying, and proved the soundness of the scheme that had been devised to meet sudden emergencies of this description." During the year ended March 31, 257,150 tickets, valued at £1,607 were issued to soldiers, Belgian refugees, etc. For a considerable period the tickets for soldiers have been issued by the commanding officers only to men domiciled outside the first penny stage from the centre of the city, and their use is prohibited after 6 p.m. and on Saturdays and Sundays. Important developments of the parcels department of the tramways during the past few years are the conveyance of milk for infants from the municipal milk depot and of food to the schools for the Education Committee. 887,114 packages were handled last year, including 137,694 milk bottles, the latter showing an increase of 97,556. Enlistments and the training of many new boys have contributed to the resources of the department being taxed to the utmost to get the food to the various schools in time. Motor vans have to be hired to assist in the work. Ferro-concrete foundations were used last year in replacing the fractured foundations of the Leeds Road and Stanningley tramways. The old girder rails, which have many years' life in them, have been re-used and the joints welded where necessary. Part of the extension to Bingley was given a ferro-concrete foundation. The rails of the girder type, weighing 105 lb. per yard, were welded by the Thermit process.

DARLINGTON.

INSTRUCTION OF WOMEN IN DRIVING.

Objection was raised at the September meeting of Darlington Council to the Tramways Committee having allowed several women to be instructed in driving. Alderman C. W. Starmer, chairman of the committee, stated that the shortage of men had become so great that it was deemed necessary to allow women to qualify as drivers, in order that they would be ready if required. If there were no women ready to drive, it would probably mean closing the service. The committee had agreed to keep open the positions of all men who enlisted.

GLASGOW.

RECORD RECEIPTS.—A LINE USED WITHOUT SANCTION.—INSPECTION OF TRAMWAYS DEPARTMENT.—SEATS FOR WOMEN CONDUCTORS.

The takings on the tramways for the week ended September 18 constituted a record. The total was £23,093. Next highest week's takings was £23,078 for the first week in January, 1913. On the understanding that Glasgow Corporation will obtain powers at the earliest opportunity to purchase land for the widening of Spier's Bridge, Thornliebank, the Board of Trade do not propose to take further action at present in regard to the use without sanction of the single line of tramway in that thoroughfare. It is proposed to include the matter in an application for a provisional order. The members of the Tramways Committee, accompanied by Lord Provost Dunlop, and other members of the Corporation, on September 10, made the annual inspection of the works of the tramways department, including the new Govan depot. The latter provides accommodation for 160 cars. At the luncheon, the Lord Provost, in proposing the health of Councillor R. Kirkland, the convener of the Tramways Committee, said that the department was held up as an example, and it was probably the most successfully managed system in the world. That day's inspection had proved the assertion beyond contradiction. Ex-Baillie Kirkland, in reply, said his term of office expired in November, and he wished to acknowledge the support he had received. He mentioned that for some months the employees had been engaged in the manufacture of munitions. As an experiment, seats have been hung from the stair rail of some of the cars for the use of the women conductors.

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LONDON.

Pressure of Woolwich Traffic.—Statistics of Licensed Employees.—Refusal of Licenses to Men under 21.—Rear Lights.

In order to meet the demand of the Arsenal traffic at Woolwich, the London County Council tramways department are increasing the machinery of the sub-station in that district. The work, however, cannot be completed until the end of the year. On both the London and Abbey Wood sides of Peresford Square the traffic is hindered by single lines. Under the Defence of the Realm Act powers are given to the military authorities to demolish buildings, and the needs of the Arsenal surely call for the removal of objections that for years have served to obstruct public improvements and now impede munition work. During the hearing of summonses against Dartford Tramways Company for employing unlicensed men, a representative of the public carriage office, Scotland Yard, produced a return of the number of carriages and drivers in the Metropolitan area. This showed three licensed men to every vehicle. These figures had taken into consideration all those who had enlisted, amounting in the case of drivers to 4,023 and conductors 2,999. Reporting on the summonses against the manager of the tramways company, Dartford Tramways Committee state that the Chief Commissioner will not issue licenses to men under 21 years of age, and the clerk had been instructed to suggest to Balfour, Beatty and Company, Limited (the tramway lessees), that unless the Commissioner will relax the rule for the period of the war, they should lay the facts before the Minister of Munitions and inform him that it will be impossible to provide proper facilities for conveying workmen to the munition works. At the Trade Union Congress this year the Parliamentary Committee were instructed to secure legislation to prohibit the employment of conductors under 21 years throughout the country. Steps are to be taken to enforce the Home Office regulation that in the London area all vehicles, including cycles, shall carry a rear light.

NEWCASTLE-ON-TYNE.

Trail Cars. Track Maintenance.—Sunday Pay of Women.—Depot Enlargement.

To assist in carrying on the rush traffic, trail cars are now in use on the Corporation tramways. In his report for the year ended March 31 last, Mr. W. J. Steele, city engineer, and permanent way engineer to the tramways department, says:—"The length of tramway opened for service, measured as single track, is 64¾ miles. The maintenance of the permanent way was £8,199, or £128 per mile; in addition to ordinary maintenance, £6,771 was expended in renewals, equivalent to £105 per mile; so that the total cost of the permanent way was £14,970, or £233 per mile. Except for the shortage in labour, the cost of renewals would have been much higher, but for the reason stated it was impossible to put many renewal works in hand. A considerable length of the permanent way is now in urgent need of renewal, and will have to be done immediately a sufficient supply of labour can be obtained. The major portion of the track has been in use for nearly 14 years, and it is now necessary to establish a systematic renewal which will be constant." The Tramways Committee have been authorised to purchase land for enlarging Wingrove depot and building offices. The female conductors have been granted time and a quarter for Sunday work, but the Tramways Committee refused their application for a war bonus of 2s. 6d. a week for householders and 1s. 6d. for single women.

SALFORD.

Permanent Way Work.—New Cars on Order.

Since 1908 about 14½ miles of permanent way have been relaid at Salford. In his annual report, Mr. G. W. Holford, the general manager, states that nearly all of the relaying has been done with rails of Sandberg specification, which it is anticipated will give a longer life. The joints have been welded by the Thermit process. The joints of an additional six miles of rails have been electrically welded. During the past year the Corporation gave an order for the supply of 24 new bogie truck cars, 12 to be equipped with outer deck covers. Deliveries will be made during the ensuing months. At the end of the year the tramways department had 200 cars made up of 83 double-deck, single truck (two motor equipment), 10 of the foregoing with vestibule ends, 56 of the same type with outer deck covers, 20 double-deck bogie truck, with outer deck covers (four motor equipment), one double-deck bogie truck, with outer deck cover (four motor equipment), vestibule ends, four double-deck bogie truck (two motor equipment), and 26 of the latter with four motor equipment.

SOUTHPORT.

Increased Speed and Fewer Stops.—Electrical Clocks.

In his annual report the general manager of Southport tramways states that, owing partly to the freedom from accidents in the past, the Board of Trade, in September, 1914, granted permission for increased rates of speed, and the abolition of several Board of Trade compulsory stops in various parts of the borough. Owing to serious trouble with the electrical clocks caused by faults developing on the underground cables, the Tramways Committee decided to have the circuit rewired on the overhead system. The clocks have since been more satisfactory.

PATENT LIST.

Specially abstracted for "The Tramway and Railway World" from the Official Journal of Patents.

*** If the inventions have been communicated the names of the communicators are given below in italics.

Applications.

The following Applications for Letters Patent have been filed:

12,100 Traction trolley wheels—A. E. Fike.
12,107 Axle-boxes for railway wagons—A. S. and S. T. Rigley.
12,123 Rail joints—H. A. Gill (*Hatfield Rail Joint Manufacturing Company*).
12,144 Apparatus for use in distributing tickets—G. A. Bishop, T. B. Kitson, and W. Mottershead.
12,155 Fluid-pressure breaking apparatus—Westinghouse Brake Company, Limited.
12,227 Detachable rims for the wheels of motor vehicles—F. W. Baker.
12,351 Automatic electrical signalling on railways—W. A. Minchin.
12,382 Shield to prevent punctures to tubes of car wheels—W. C. Webb.
12,432 Composition brake blocks—A. McCabe.
12,487 Tram and railway ticket holder—T. Bowden.
12,538 Railway brakes—F. E. Feesey.
12,551 Compressed air brakes—F. J. Chapsal and A. L. E. Saillot.
12,567, 12,568, 12,569 Railway signalling systems and train controlling apparatus—A. F. Bound and W. Rowland.
12,582 Railway signalling systems—O. A. Ottosson.
12,713 Railway rolling stock—G. H. Sheffield and F. R. Rand and Company, Limited.
12,755 Lifeguards for mechanically propelled vehicles—W. H. Stidworthy and J. E. Hunt.
12,848 Trolley heads—G. R. Taylor.
12,895 Brake apparatus for railway vehicles—E. S. Luard and G. H. Willans.
12,925 Fluid-pressure braking apparatus—Westinghouse Brake Company, Limited.
12,953 Carriage body for motor vehicles, road and railway cars—H. Arquint.
13,214 Automatic railway signalling train control—W. H. Biddle.
13,241 Working points or switches on light railway tracks—A. Rogers.
13,289 Means for securing traction for vehicles—D. M. Macfarlane, J. Anderson, and G. H. Robinson.
13,573 Steering gear of motor lorries, etc.—Fodens, Limited, and E. R. Foden.
13,585 Interchangeable wheels for motor vehicles—W. Douglas.

Specifications Published.

1914.

11,715 Railway signalling systems—Siemens Brothers and Company, and Boot.
11,940 Electric signalling installations—Siemens Brothers and Company (*Siemens and Halske Akt.-Ges.*).
12,443 Insulator for the overhead conductors—Libano.
13,213 Tightening devices for overhead conductors—Siemens-Schuckertwerke.
14,683 Tensioning arrangements for electric conductors—Siemens-Schuckertwerke.

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Leather Clothing, Caps, Leggings, Belts, Pouches, and Waterproofs, for Tramway, Omnibus & Municipal Staffs, manufactured by

Hazel & Co.

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Wanted to hire, twenty double-deck (without top cover) single-truck cars, with or without electrical equipment.

Address, Box No. 165, TRAMWAY AND RAILWAY WORLD, Amberley House, Norfolk Street, London, W.C.

FOREMAN PLATELAYER.

Wanted, working foreman platelayer, permanent job. Apply, giving particulars of experience and wages required, Engineer and Manager, Rhondda Tramways Company, Limited, Porth, Glam.

FOR HIGH-CLASS

CONDENSING PLANT

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AILSA OILSKINS

Give Genuine Satisfaction.

Lady Conductors' and Motormen's Coats.

Write for sample of latest improved pattern, specially adapted to withstand the excessive friction at sleeves and under arms in driving.

The Manager of a well-known tramway company writes:—"Past results have been so satisfactory that we have this year decided to place the whole of our order in your hands."

AILSA OILSKIN CO.,

Manufacturers, Dalry, near Glasgow.

15,176 Tramway rails—Thon.
15,642 Apparatus for the control or operation of railway points—Siemens Brothers and Company (*Siemens and Halske Akt.-Ges.*).
18,652 Railway points—Lebeau.
11,629 Electrically-controlled point-operating mechanism—Collins.
11,630 Electric railway systems—Collins.
16,661 Means for pulling off electrical overhead conductors—Siemens-Schuckertwerke Ges.
18,307 Front axles for motor vehicles—Girling and Despatch Motor Company.
18,334 Starting devices for the engines of motor-propelled vehicles—Finch, Wordingham, Loftus and Lambourne
18,363 Guard for motor road vehicles—Stroud.
21,059 Motor trains—Reik, and Oesterreichische Daimler-Motoren Akt.-Ges.
22,113 Overhead conductor arrangements for use at cross-overs or switches on electric railways—Burdon (*Siemens-Schuckertwerke Ges.*).
24,820 Rail joints—Such.
17,841 Motor road vehicles—Splitter.
18,758 Suspension of the trucks of tramway vehicles—Peckham, Thomas and Andrews.
18,857 Driving mechanism of motor vehicles—Calvert.
18,954 Electro-magnetic circuit controlling devices for railway signalling—Gardner.
18,972 Manufacture of railway or tramway rails—Sandberg.
19,399 Keys for holding down railway and tramway rails in their chairs—Green.
22,816 Differential gear for motor road vehicles—Daimler Company, and Berriman.
22,898 Water tube boilers—Babcock and Wilcox, Limited.
24,487 Car couplings—Olivero.
19,022 Railway spikes or securing devices—Joors.
19,159 Axle-boxes for railway and tramway vehicles—Preston.
19,238 Electro-magnetic track brakes—Storjohann.
19,659 Power transmission for motor vehicles—Rouse.
20,730 Double-decked vehicles—Spangler.
21,157 Points of tracks for electrically-driven vehicles—Cumming.
17,954 Compressed-air brakes—Janse.
19,534 Running indicator for railway rolling stock, tramcars, or omnibuses—Holford.
22,576 Axle-boxes—McWilliams.

1915.

5,191 Train-stopping apparatus—Shultz.
1,285 Spring-controlled brake—"Vulkan" Machinenfabriks Akt.-Ges.
8,040 Construction of motor vehicles—Morin.
3,679 Securing railway rails to sleepers—Sheehe.
8,375 Fluid-pressure braking apparatus—Donovan.
5,437 Sliding doors for railway cars—Constable and Snodgrass.
6,974 Vehicle seats—Sturges.
8,189 Accumulator cases for motor vehicles—Mossay.

Colonial and Foreign Tramways Traffic Returns.

NAME OF COMPANY.	1914. WEEKS ENDED.					1915. WEEKS ENDED					AGGREGATE.		
	Aug. 29	Sept. 5.	Sept. 12.	Sept. 19.	Sept. 26.	Aug. 28.	Sept. 4.	Sept. 11.	Sept. 18.	Sept. 25.	Wks.	1915.	Increase or Decrease.
	£	£	£	£	£	£	£	£	£	£		£	£
Anglo-Argentine	49.000	45.897	53.640	51,235	49,012	48.885	49.780	49,469	47,626	50.319	38	1,930.886	−138,404
Auckland	21.046	(28 days)	...	...	...	19.876	(28 days)	...	...	...	8	42.029	− 2.328
Burma ... ... Rs.	3.566	3.598	3.752	3.638	3,483	5.174	3.726	3.839	3,464	3.463	...	...	+ 1.028
Calcutta ... ... Rs.	65.247	68.947	66.296	66.051	66.575	65.282	65.484	66.662	67.387	62.872	38	2.516.528	−104.739
Hong Kong ... ... $	9.752	9.646	10.761	10.271	9.150	11.407	11.656	12.173	11.424	11.831	39	448.623	− 19.836
Madras ... ... Rs.	29.529	(14 days)	27.257	(14 days)	...	32.632	(14 days)	30.845	(14 days)	...	36	499.757	+ 6.862

Companies Issuing Monthly Statements.

	1914.						1915.						Wks.	AGGREGATE.	
	March.	April.	May.	June.	July.	August.	March.	April.	May.	June.	July.	August		1915.	+ or −.
	£	£	£	£	£	£	£	£	£	£	£	£		£	£
Brazilian Street Mlrs.	...	...	...	...	...	...	...	...	...	...	...	...	...	—	—
BrazilianTraction Mlrs	6153984	5.941.220	6.180.830	6.188.900	6,462.860	6166100	6294910	6.333.460	6.670.110	6.591.940	6.703.000	6576000	35	50.963.110	+1.889.962
Brisbane	28.325	28,610	29,860	28.590	29.660	33,172	30.740	29.890	31.780	29.880	31.150	35.064	35	244.714	+ 12,887
British Columbia $	717.251	698.508	678.314	660.383	690.023	674,812	557,135	540.861	512.568	498.093	510.723	507,126	9	1,017,849	− 346,986
Buenos Aires Pt. & C.	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Buenos Ayres Lacroze	...	...	...	...	43.328	40,508	...	...	...	...	41,460	41,468	9	82.928	− 908
Cape Town	...	...	...	...	...	...	...	...	...	...	13,960	...	5	13,960	—
Carthagena& Herrerias	2,425	2.069	2.202	1,405	2,416	2.758	2,436	1,496	1,931	2.059	2.157	1,523	35	14.328	− 4,642
Cordoba	...	13.406	14.667	13.974	14.165	13.371	...	13.607	14,458	14,091	14,373	14,157	22	70,724	+ 1,141
East India	1,884	1,837	1.885	1,966	2.045	2,112	1,846	...	2.119	2.194	2.231	2,266	5	2.266	+ 154
Kalgoorlie	2,476	2.820	3.025	2,692	2.552	...	2,638	2.841	3.269	2.707	2.775	...	31	18.954	+ 880
La Plata	5,178	4,716	4,727	4,560	4.358	4,060	4,582	4.269	4,489	3.876	4.055	4,165	35	33,992	− 3,670
Lima	34,665	34,153	33,215	33,499	34,627	29,898	34,180	31,615	31,700	31,650	33,344	32,011	36	257,715	− 13,991
Manila ... ... $	137,200	134,300	138,600	132,500	133,900	128,500	119,984	117,450	120,475	116,875	123,750	126,650	35	976,343	− 121,253
Melbourne	63,000	...	...	...	..	...	64,506	...	...	...	63,432	...	—	—	—
Mexico ... ... $	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Montevideo ...	32,630	29,650	29,016	28,049	26,417	26,075	29,716	26,786	27,771	24,266	25,161	26,493	43	278,346	− 31,392
Port Elizabeth ..	...	...	...	...	...	...	...	...	...	...	3,362	...	5	3,362	—
Puebla ... ... $	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Rangoon	6,475	5,367	5,323	4,997	4,975	4,629	5,217	4,964	4,887	4,997	4,629	4,510	35	38,884	− 3,054
Toronto ... ... $	836.328	830.299	871,733	861,938	866.221	850.639	820.750	795.816	795.262	787,558	773.013	762.627	35	6.345.703	− 397,083
Winnipeg ... $	347,812	337,414	337,664	335,012	346,630	322,762	303,209	264,856	263,302	255,549	248,022	251,189	35	2.251,467	− 509,477

(*Continued on page 310*)

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TRAFFIC RETURNS—*continued.*

Tramways and Omnibus Undertakings in the United Kingdom.

NAME OF COMPANY OR CORPORATION.	1914. WEEKS ENDED.					1915. WEEKS ENDED.					AGGREGATE.		
	Aug. 29	Sept. 5	Sept. 12	Sept. 19	Sept. 26	Aug. 28	Sept. 4	Sept. 11	Sept. 18	Sept. 25	Wks.	1915.	Increase or Decrease.
	£	£	£	£	£	£	£	£	£	£		£	£
Aberdeen Corporation	1.626	1.723	1.593	1.548	1.508	1.961	1.927	1.869	1.901	1.673	16	30.653	+ 979
Accrington Corporation	487	485	496	492	510	569	556	633	591	617	25	14.383	- 251
Ayr Corporation	441	349	335	413	284	523	407	442	558	340	19	9.458	+ 386
Bath Electric	*	...	...	...	...	...	...	...	...	...	—	—	—
Birkenhead Corporation	1.229	1.339	1.252	1.247	1.257	1.462	1.419	1.499	1.464	1.422	25½	35.829	+ 2.610
Birmingham Corporation	11.105	11.387	11.298	11.435	11.671	15.146	14.899	15.515	15.535	15.404	26	353.068	+ 37.634
Blackburn Corporation	1.295	1.221	1.275	1.243	1.406	1.286	1.238	1.364	1.503	1.563	26	35.306	- 610
Blackpool and Fleetwood	1.337	1.606	1.301	952	994	1.899	1.977	2.146	1.608	1.304	38	33.386	- 458
Blackpool Corporation	2.417	2.627	2.549	1.820	1.808	3.555	3.540	4.203	3.465	2.674	26	56.953	+ 406
Bolton Corporation	2.689	2.982	2.915	2.597	2.522	2.859	2.759	3.423	2.773	2.677	26	70.519	- 3.114
Bournemouth Corporation ...	2.249	2.124	1.988	1.877	1.865	2.703	2.652	2.570	2.509	2.167	26	60.337	+ 2.452
Bradford Corporation	6.019	5.870	5.877	5.750	5.725	6.748	6.653	6.862	6.689	6.468	25	171.879	+ 7.258
Brighton Corporation	1.311	1.379	1.718	1.102	1.160	1.601	1.405	1.497	1.386	1.278	25½	31.706	- 244
Bristol	8.638	9.378	10.064	8.692	8.326	10.222	10.365	8.828	10.169	9.761	38½	366.098	+ 32.729
Burnley Corporation	1.308	1.396	1.469	1.405	1.352	1.558	1.653	1.909	1.743	1.576	26	42.195	- 1.462
Burton-on-Trent Corporation ...	298	301	301	295	285	298	295	312	309	300	26	7.611	- 354
Bury Corporation	1.540	1.877	1.484	1.362	1.320	1.457	1.403	1.635	1.410	1.487	25½	36.406	- 1.209
Cardiff Corporation	2.752	2.877	2.862	2.710	2.654	3.005	2.797	2.925	2.914	2.804	25	70.891	- 3.338
Chatham and District	1.061	1.138	1.165	1.042	1.040	1.426	1.301	1.372	1.368	1.377	38	44.880	+ 8.549
Chesterfield Corporation	259	259	244	241	241	294	275	283	292	276	25	6.956	- 182
Colne Corporation...	229	234	230	244	204	268	275	312	358	255	—	—	—
Cork Electric	507	544	549	486	489	562	554	559	577	559	38	19.286	- 59
Croydon Corporation	1.688	1.774	1.719	1.576	1.683	2.002	1.831	2.007	1.995	1.970	26	48.931	+ 3.222
Darlington Corporation	302	285	292	276	262	297	295	296	296	276	25½	6.973	+ 54
Derby Corporation	988	1.012	1.018	973	943	1.125	1.050	1.136	1.104	1.071	25½	27.553	+ 548
Dover Corporation	278	286	283	266	261	397	335	378	368	334	25	8.518	+ 1.629
Dublin and Lucan	154	157	154	132	150	177	183	171	173	179	12	2.096	+ 33
Dublin United	6.077	6.055	6.027	5.586	5.662	6.551	6.257	6.561	6.645	6.469	38	234.398	+ 8.849
Dundee City	1.284	1.286	1.294	1.259	1.214	1.445	1.410	1.443	1.465	1.369	18½	25.884	+ 1.100
East Ham Corporation	1.218	1.260	1.248	1.205	1.136	1.382	1.335	1.372	1.341	1.299	25½	34.261	+ 5.341
Exeter Corporation	368	397	377	356	343	462	424	433	427	407	25	10.241	+ 606
Gearless Motor 'Buses	*	...	...	...	...	...	...	...	...	...	—	—	—
Glasgow Corporation	19.774	20.342	20.609	20.042	19.683	21.341	22.530	22.947	23.117	22.277	17	364.838	+ 25.944
Glossop (Urban Elec. Supply Co.)...	125	112	126	119	112	157	123	145	149	151	39	4.881	- 19
Halifax Corporation	2.389	2.212	2.310	1.977	2.091	2.564	2.467	2.515	2.538	2.238	25	58.853	+ 438
Hastings and District	1.234	1.307	1.263	1.041	1.002	1.644	1.374	1.517	1.389	1.273	38	38.566	- 2
Huddersfield Corporation	2.185	2.233	2.503	2.199	2.413	2.782	2.734	3.535	2.688	2.674	25	70.896	+ 9.133
Hull Corporation	2.923	2.932	3.051	2.984	2.946	3.092	3.016	2.992	2.983	3.078	25	77.922	- 2.876
Ilford U.D. Council	615	618	594	577	561	709	663	656	664	652	25	17.206	+ 2.676
Ilkeston Corporation	133	130	125	122	125	142	144	148	147	137	26	3.557	+ 59
Ipswich Corporation	494	498	476	427	429	713	591	669	614	586	24	14.952	+ 2.246
Isle of Thanet	1.256	1.191	1.115	915	736	1.063	756	868	735	536	51	22.493	- 10.929
Kilmarnock Corporation	153	155	147	157	147	168	172	191	176	162	19	3.356	+ 63
Lanarkshire	1.848	1.919	1.901	1.750	1.776	2.173	2.150	2.251	2.328	2.172	38	74.325	+ 2.041
Lancashire United	1.673	1.680	1.793	1.566	1.616	1.943	1.859	2.241	2.111	1.889	38	66.946	+ 3.772
Leeds City	7.860	7.683	7.831	7.765	7.678	9.625	9.101	9.378	9.398	9.084	26	233.883	+ 17.815
Leicester Corporation	2.689	2.707	2.681	2.613	2.652	3.236	3.044	3.247	3.227	3.222	39	116.252	+ 5.403
Leith Corporation...	703	701	681	648	683	753	785	827	787	794	19	15.185	+ 724
Leyton U. D. Council	1.432	1.443	1.429	1.296	1.265	2.138	1.718	1.757	1.648	1.641	25	42.414	+ 6.034
Liverpool Corporation	13.047	13.236	13.265	12.922	12.916	14.082	13.913	14.069	14.206	13.977	38	512.479	+ 4.020
Llandudno and Colwyn Bay ...	521	493	464	393	328	679	645	605	523	437	43	15.139	+ 1.272
London County Council	42.575	43.068	43.541	42.526	41.976	47.720	46.219	48.130	48.414	46.960	25	1.095.822	- 4.285
London General Omnibus... ...	*	...	...	...	...	...	...	...	...	...	—	—	—
London United	*	...	...	...	...	...	...	...	...	...	—	—	—
Lowestoft Corporation	310	282	250	210	192	199	161	154	148	140	51	9.018	- 2.234
Maidstone Corporation	224	219	229	217	278	242	226	253	260	250	24	5.837	+ 51
Manchester Corporation	16.042	17.035	16.777	16.330	16.582	18.282	18.530	18.802	18.466	18.408	25	463.547	+ 11.923
Metropolitan Electric Tramways ...	*	...	...	...	...	...	...	...	...	...	—	—	—
National Steam Car	*	...	...	...	...	...	...	...	...	...	—	—	—
Nelson Corporation	189	152	162	158	148	191	216	252	233	186	25½	5.138	- 130
Newcastle-on-Tyne Corporation ...	5.282	5.716	5.787	5.765	5.646	6.566	6.531	6.636	6.541	6.523	25	162.678	+ 23.390
Newport (Mon.) Corporation ...	808	1.142	829	817	780	926	857	880	910	865	26	22.002	- 55
New St. Helens and District ...	1.108	1.093	1.089	996	992	1.204	1.131	1.224	1.291	1.149	12	14.329	+ 2.175
Northampton Corporation... ...	522	638	647	615	595	768	691	751	771	732	25	19.465	+ 4.057
Nottingham Corporation	3.297	3.304	3.317	3.262	3.183	3.949	3.795	3.904	3.875	3.739	25	95.994	+ 6.542
Oldham Corporation	2.244	2.851	1.957	2.005	2.039	2.510	2.552	2.554	2.344	2.336	27	62.896	+ 1.066
Portsmouth Corporation	*	...	...	...	...	...	...	...	...	...	—	—	—
Preston Corporation	880	937	1.055	1.032	958	975	1.035	998	1.031	994	25	24.553	+ 191
Provincial...	2.261	2.344	2.291	2.070	2.103	2.919	2.508	2.762	2.594	2.420	51	112.611	+ 11.546
Reading Corporation	700	751	746	716	650	871	827	891	843	829	25	20.643	+ 2.011
Rhondda Tramways	1.220	1.310	1.269	1.184	1.217	1.242	1.247	1.242	1.258	1.250	38	44.821	- 2.553
Rochdale Corporation	1.827	2.035	1.945	1.484	1.465	1.715	1.807	1.964	1.763	1.767	25½	45.408	+ 1.286
Rotherham Corporation	1.008	1.095	1.097	1.089	1.151	1.200	1.193	1.238	1.207	1.189	26	30.351	+ 3.102
Salford Corporation	4.695	5.357	4.632	4.682	4.859	5.319	5.418	5.657	5.365	5.283	25½	136.900	+ 3.892
Sheffield Corporation	7.231	7.468	7.329	7.380	7.660	9.311	9.164	9.519	9.329	9.373	26½	235.210	+ 29.260
Southampton Corporation... ...	1.404	1.423	1.404	1.263	1.209	1.779	1.701	1.682	1.668	1.660	25	38.806	+ 3.078
Southend-on-Sea Corporation ...	1.468	1.452	1.375	1.163	968	1.288	1.136	1.074	992	808	25	23.852	- 6.974
South Metropolitan Tramways ...	*	...	...	...	...	...	...	...	...	...	—	—	—
South Shields Corporation ...	751	756	736	727	695	923	844	848	820	799	25½	21.009	+ 438
Sunderland Corporation	1.474	1.557	1.448	1.354	1.378	1.622	1.539	1.598	1.516	1.492	26	39.294	- 797
Sunderland District	525	491	535	538	509	667	609	604	596	544	47	26.768	- 695
Swindon Corporation	188	193	187	179	179	222	217	213	219	223	25	5.166	+ 533
Torquay Tramways	677	694	627	556	530	924	819	816	749	669	38	21.892	- 700
Tramways (M.E.T.) Omnibus Co. ...	*	...	...	...	...	...	...	...	...	...	—	—	—
Tyneside Tramways and Tramroads	691	765	818	740	716	712	652	662	667	594	12	8.033	- 73
Wallasey Corporation	1.350	1.356	1.313	1.259	1.177	1.536	1.447	1.485	1.425	1.321	25½	35.091	- 31
Walsall Corporation	599	606	625	615	604	838	765	811	828	801	39	28.374	+ 4.040
Walthamstow U.D. Council ...	878	898	851	765	748	1.182	905	972	937	895	26	25.055	+ 3.047
Warrington Corporation	422	426	431	431	426	455	463	467	479	461	25	11.531	+ 380
West Ham Corporation	2.797	2.850	2.823	2.764	2.664	3.737	3.184	3.245	3.149	3.114	25	80.517	+ 7.931
Wigan Corporation	1.381	1.401	1.409	1.390	1.395	1.574	1.555	1.587	1.653	1.567	25	38.747	+ 1.058
Wolverhampton Corporation ..	975	1.006	965	933	1.023	1.126	1.134	1.155	1.154	1.118	26	29.393	+ 1.149
Yorkshire (West Riding)	1.422	1.463	1.394	1.387	1.352	1.736	1.657	1.746	1.607	1.551	39	62.172	+ 5.222

* TRAFFIC RETURNS SUSPENDED.

Owing to the European war, the Government have taken over the railways of Great Britain as from August 4, 1914, and the issue of traffic returns has been suspended. Consequently the traffic returns of the electric railways which usually appear on this page cannot be given.

The Publication of the Traffic Returns of the Tramways marked with an asterisk in the above table have also been suspended during the war.

TRAMWAY DIRECTORIES.

A useful feature of this issue is the directory of electric railways and electric tramways which will be found among the advertising pages. This directory contains the names of the chief officals and the principal particulars relating to each undertaking.

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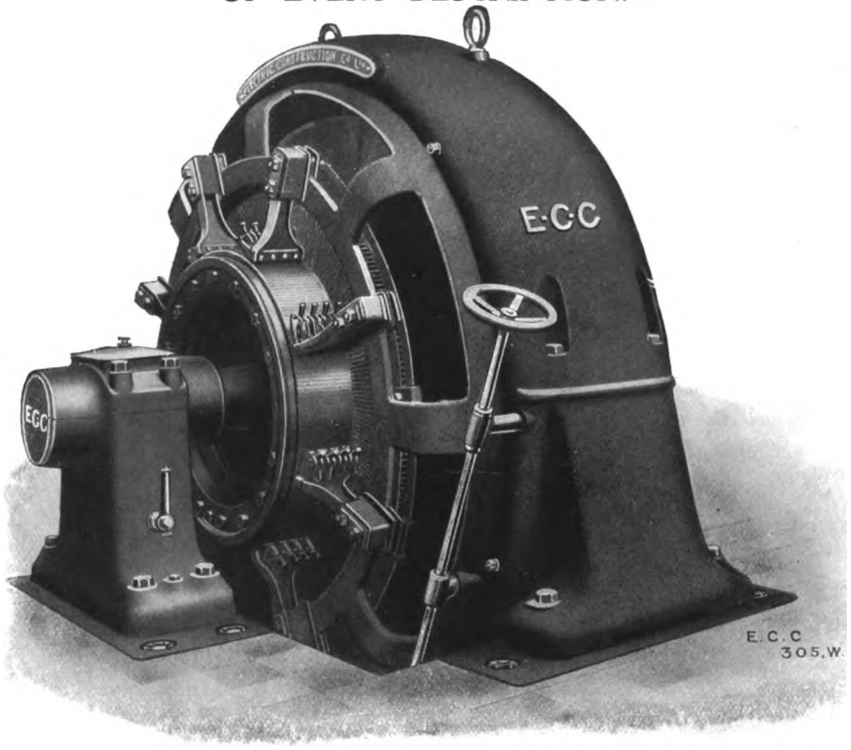

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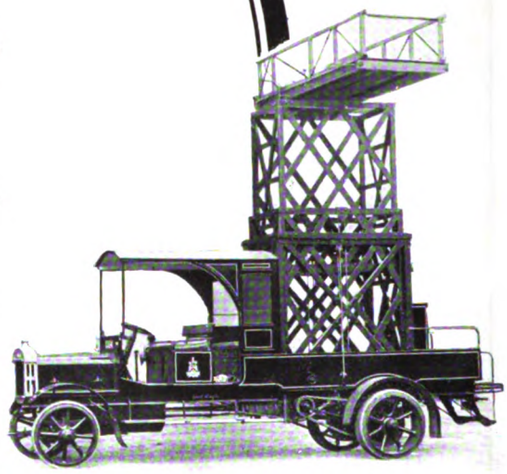

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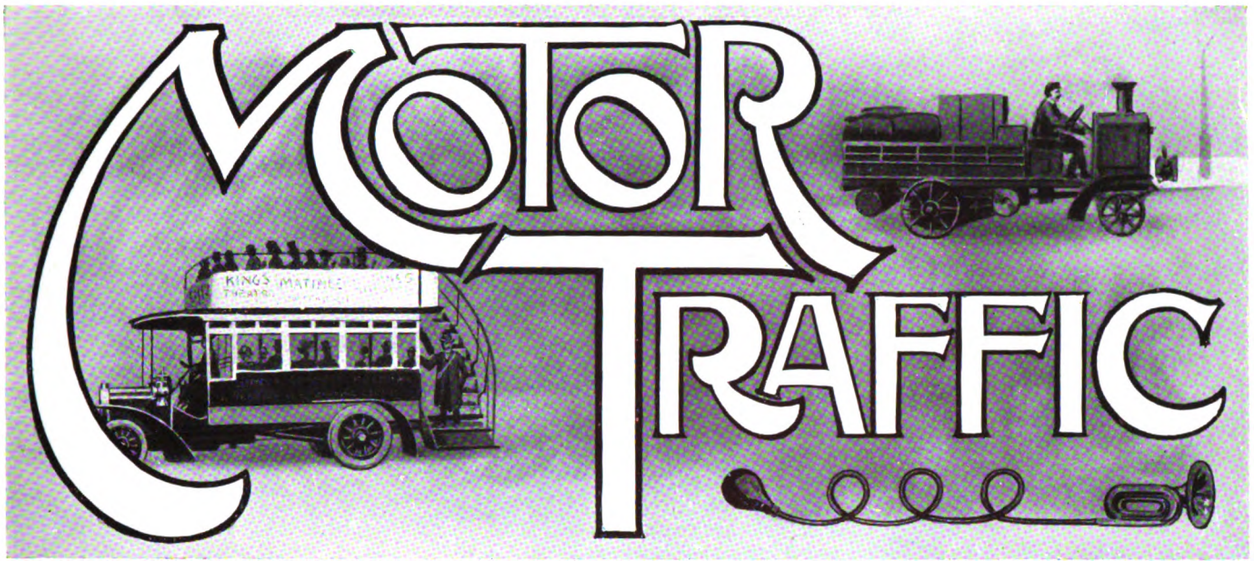

Mr. McKenna's great War Budget directly affects all users of industrial motor vehicles through the medium of the proposed increase in the petrol tax. It is suggested that the tax on the fuel of industrial motors should be increased by 3d. per gallon, making the total 4½d. per gallon. As a simple example of the effect of this tax, we may take the case of an industrial vehicle running 12 miles on one gallon of petrol, and covering 80 miles per day for six days of the week. The additional cost of operation due to the tax in this case would be 10s. a week, or, say, £25 per annum. The additional charge on the operation of motor omnibuses would be considerably greater, amounting probably to not much less than £40 or £50 per annum for each vehicle. For motor chars-a-bancs, the figure would be much lower on account of the smaller mileage covered. For motor cabs, the additional charge would be about 5s. a week, which is a very serious tax on the whole earned income of the owner-driver. It would also bear very hardly on operating cab companies, since the tariff chargeable is fixed by law, and the profits even now are very small. The hardest case of all is that of the haulage contractor, who is caught between two contracts. On the one hand, he has undertaken to carry out certain delivery or haulage work at a certain price, his contract in the majority of cases binding him for not less than a year. On the other hand, he has covered himself by a contract with the petrol importers, upon the rates of which he has to some extent at least based his charges for delivery and haulage. His petrol contract is now altered by the amount of the tax. On the other hand, he cannot throw this burden on to the various firms whose work he is doing. The serious nature of these facts led Mr. Lloyd George, when the first petrol tax was imposed, to accept in some measure the proposals put before him by a deputation organised by *Motor Traction*, and introduced by the Hon. Arthur Stanley, M.P. The final result of this deputation was a concession under which industrial vehicles were made exempt from tax during the first nine months of its normal operation in other quarters. A precedent in this direction had already been established in connection with the taxation of exported coal. This precedent was further strengthened by the instance just mentioned, and it would therefore appear reasonable that some similar concession should be granted in the present case. It is conceivable, however, that it might be limited to specific branches of the industry, and made to cover only trade vehicles and such passenger-carrying vehicles as operate under a tariff fixed by law. The remainder have, of course, the option of increasing their fares so far as this is possible in view of competition. The natural consequence of the tax as it affects public passenger and commercial vehicles is to prejudice local authorities in an arbitrary manner against the system upon which the tax is levied, this being, as we now know, a system which brings into existence fleets of vehicles of great service to the country in time of war.

* * * * * *

As regards the proposed taxes—subsequently withdrawn as regards commercial vehicles—on foreign imports, their consequence upon the industrial motor owner if they had remained may be briefly considered. A van or lorry of foreign origin previously costing £300 would, if the tax had become law, cost about £400. This is a maximum which might not be reached, since it is conceivable that manufacturers and distributors would bear some share of the cost of taxation. Taking the maximum for purposes of a rough estimate, the increase involves an additional capital expenditure of £100, corresponding to an annual expenditure of income of, say, £5. Putting the life of the vehicle at eight years, there is also an additional £100 to be paid off in that period. This corresponds to about £12 10s. per annum, making a total additional charge upon the user of approximately £17 10s. per annum as a maximum. The owner of a light delivery van costing not much more than £100, and lasting, say, six years, has to face an additional annual expenditure of approximately £2 on account of increased first cost, and £6 on account of higher depreciation allowance, making a total of £8 in all. It would appear therefore that the proposed import duties would not be likely as a rule to have so great an effect upon the owner of an industrial motor as has the proposed increase in the petrol tax. Moreover, the import duty only fully affects those firms who, so long as it is in operation, are obliged to purchase foreign cars. To a lesser degree it affects also those who purchase cars assembled within the British Empire, and constructed wholly or largely of foreign components. The Chancellor of the Exchequer gave no explanation of the reason why he withdrew the proposed duty on imported industrial and commercial vehicles and tires. The withdrawal must have been due to something more than the clamour raised in the House of Commons by two or three Members. Probably the reason is to be found in the fact that as yet the Government are only able to

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MOTOR TRAFFIC.

allow the home manufacturers to receive applications for chassis from firms engaged on national work. It must also be confessed that the commercial vehicle makers did not appear to figure numerously in the recent agitation for securing a tax on imported cars.

"A right appreciation of the advantages to commercial motor manufacturers of the dissemination of the information and experience gained in the Continental conflict both with the British and captured vehicles may as likely as not contribute towards gaining the ultimate victory for the Allies." The foregoing is an extract from the comments published on this page in the issue dated November 5 last, written by a correspondent then on active service. Before that date the motor transport had contributed its priceless aid to the success of the retirement on Paris, and still more to the triumph of the strategy resulting in the advance of the Allies and the driving of the Germans to the refuge of holes in the ground. Since then the motor vehicles have continued to carry out not only the routine of commissariat and hospital and troop conveyance duties behind the trenches; in addition they have figured gloriously in the tactical movements that have led to defeat of the Huns in their attempts to break through. Since those days the number of our troops on the Western front has increased to over a million, but British motor manufacturers have more than held their own in supplying the Army's needs. Indeed, they have done more than that, for, writing of the Allies' great advance at the end of last month, a correspondent at headquarters says :—" The Germans boast of their motor transport, but ours is better, and the whole business of bringing up troops and supplies and taking back the wounded was admirably managed. There was never a moment of congestion, though it is by far the biggest movement we have ever undertaken." Though for months the Allies have had to confine their activities to defence and nibbling, the interval has been well spent as regards transport work, and there is evidence that its organisation in its many aspects could not be improved upon. A motor transport company is a unit which, if seen in a London thoroughfare, would make the Scotland Yard tyros who figure in the Parliamentary witness-box faint from fear of congestion. Yet the motor transport companies number on into hundreds.

* * * * * *

Apparently there is not a weak link in the chain of control, whether it be the command, the technical management, the unit workshop, the great repair shops at the bases, or in the control at busy spots on the road. For the successful working of the latter department much credit is due to London and other police from great traffic centres who have enlisted in order to serve the country in that direction. Our motor transport is a great triumph of civilian effort, thanks to the control of matters at the War Office having been delegated to men who while being acquainted with military needs had for years figured among the leaders of the commercial vehicle side of the motor industry. Not the least of the advantages accruing from the breathing time given to the motor factories and the transport organisers by the period required for building up our New Army has been the opportunity of straightening out the repair organisation in France. The working of the vehicles amid the clash of arms, over roads torn up by shells, and often under fire, has been an experience of untold worth. We would express a hope that the engineers and business men who rule the department have not been slow to place the valued store of information that should have been gained at the disposal of British manufacturers. Their resources have been wholly at the country's service during the past thirteen months, but when peace smiles again it will be to the commercial and not the military needs of the country that they will have to look to for their sustenance. Therefore it is imperative that improvements and new devices should be tried out at once. In the article published on November 5 last we urged the adoption of that course, and it is doubly necessary now that American commercial vehicles have not only found a place in the Army but in business houses in this country. Moreover, the weakness of the Government in assenting to the withdrawal of the proposed tax of 33⅓ per cent. upon the commercial chassis has left the field open to them. We are glad to observe that our suggestion received editorial support in *Motor Traction* of the 22nd ultimo. Apparently it has to some extent been acted upon, for earlier the announcement was made that Mr. E. W. Thomas, chief engineer of Commer Cars, had been on a visit to the repair shops in France. We hope to learn that the matter has been taken in hand on properly organised lines.

WAR TAXES ON LOCOMOTION.

The Chancellor of the Exchequer, on September 21, introduced the third Budget presented since the outbreak of the war. The new taxation to be imposed includes the following :—

Duties on motor spirit increased from 3d. and 1½d. to 6d. and 4½d. per gallon. The lower rate will be payable by public passenger undertakings, business vehicles and medical men.

Import duty of 33⅓ per cent. on motor cars, motor cycles and parts.

The Chancellor of the Exchequer (Mr. McKenna) stated that the proceeds of the motor spirit tax will for the time being be retained in the Exchequer and not paid out to the Road Board. The yield this year is estimated at £550,000, and in a full year at £1,100,000. He hoped the whole of the tax would be retained by the Exchequer during the war. On motor cars and cycles he estimated that the revenue for a full year would be £1,150,000.

Rebate on Commercial Motor Spirit.

A deputation of the Commercial Motor Users' Association was on October 4 informed by the Commissioner of Customs and Excise that Mr. McKenna had, after consideration of the arguments advanced by the Association, introduced into the Finance Bill the necessary clause to secure 50 per cent. rebate of the new petrol tax to all commercial motor users who had previously been exempt to the extent of 1½d. per gallon where the full tax was 3d. per gallon.

Great satisfaction is expressed among British motor manufacturers with the duty imposed on cars, cycles and parts, the latter including tires. The duty on commercial chassis will be especially welcomed, and it is hoped that its effect will be to prevent the further invasion of the market by American machines at a time when the greater part of the home output is still being sent to the British and Russian armies at prices which are strictly regulated. An opinion largely held is that the duty is not heavy enough.

Speed and Weight of Heavy Motor Vehicles.

The Parliamentary Committee recently appointed by the Chancellor of the Exchequer to make recommendations on the subject of Retrenchment in Public Expenditure, presented their first report before the Budget was introduced. No reference was made by the Chancellor to a recommendation that an inquiry be held into the possibility of reducing the present heavy expenditure of local authorities on highway maintenance by amendments of the law restricting the speed of types of heavy motor traffic. The matter is already under consideration by an expert committee, but on account of its controversial nature and the war their sittings have apparently been adjourned indefinitely.

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MOTOR TRAFFIC.

STRAKER-SQUIRE LORRY IN THE DESERT.

We are indebted to Messrs. Straker-Squire, of Blackfriars, London, S.E., for the accompanying photograph of one of their 40 H.P. 3-4 ton machines unloading in the desert "somewhere" in the shadow of the Pyramids.

Its driver, attached to the New Zealand Expeditionary Force, says that the lorry gives a very good average in the way of petrol consumption, and keeps remarkably cool in spite of the extreme heat. It has never so far given a moment's trouble.

The vehicle has done the work of three general service wagons, and its reliability is thus clearly indicated.

It is by no means a new vehicle, as it was manufactured to meet ordinary trade requirements, and was shipped to New Zealand some time ago, being commandeered by the Dominion military authorities on the outbreak of hostilities.

Experimental Service at Burton.

An inquiry was held on September 7, at Burton-on-Trent, by a Local Government Board Inspector, into the application of the Corporation for a provisional order empowering them to run omnibuses and motor cars within the borough. It was stated that it was not proposed to have anything more than an experimental service to a district that had petitioned for facilities, and that nothing would be done during the war. Mr. T. Hall, borough electrical engineer, said he favoured the electric omnibus. The capital expenditure would be about £1,200, as compared with £6,000 per mile for a tramway track and providing a car. The special features of the system were the economy, the very sound running, and the general cleanliness and simplicity.—The Inspector: How long will the omnibus last?—Mr. Hall: Ten years. He added that in a certain town £500 was paid for petrol for one car annually, while the cost of electricity would be £365.

Straker-Squire Lorry with New Zealanders in Egypt.

BATTERY-DRIVEN VEHICLES.

Edison Omnibuses at South Shields.

The report of the South Shields Corporation Tramways for the year ended March 31 last is signed by Mr. W. T. Robson, who recently resigned to accept the position of general manager of Southampton Corporation Tramways. Referring to the Edison accumulator omnibuses, Mr. Robson says that the bold decision to adopt them placed the Council in the position of pioneer in this type of traction. That their example has already been followed in several other towns is sufficient proof—if proof were needed—that their courage was justified; and the reliability and freedom from breakdowns, together with the low running costs, has, adds Mr. Robson, undoubtedly proved the wisdom of the course taken. During the period of eight months, 156,203 passengers were carried by the omnibuses and 22,197 miles run. The receipts amounted to £607, or 6·55d. per mile. Although this was scarcely sufficient to meet all charges, including depreciation, Mr. Robson points out that the omnibuses were designed primarily as feeders to the tramways, and it is highly probable that any apparent deficit will be more than made up by the increased takings on the cars. Over 39,000 units have been used on these vehicles, and this represents an increase in the revenue of the electrical department of £159.

Electric Omnibuses for York.

Sanction has been received to the Corporation of York's application to borrow £5,530 for providing electric omnibuses, and £650 for a garage and charging apparatus.

Work of the Electric Vehicle Committee.

An instance of what can be effected by publicity and reliable advice is recorded in the fourth quarterly issue of the *Electric Vehicle*, the official organ of the Electric Vehicle Committee. "A copy of the *Electric Vehicle* for June last was received," the editor states, "by Messrs. George H. Hirst and Company, Limited, of Dewsbury, among other users of vehicles in the area of the Dewsbury Electricity Department. The interest thus aroused led to our receiving, in the month of June, an inquiry relating to an electric vehicle. The firm was put in touch with the various manufacturers, and the inquiry led to an order being placed early in July for a 4-ton Edison vehicle. This incident illustrates our contention that the claims of the electric vehicle have only to be made known to possible users in order to bring about satisfactory business."

The leading article observes that while all the capable drivers of petrol vehicles are at the front or engaged more or less directly on war work at home, the electric vehicle has the advantage that drivers of horses can be transformed in a day or two into trustworthy drivers of the new cars. A report is given of a demonstration in refuse collection in Sheffield by a 2-ton electric tipping wagon, which resulted in a sub-committee of the Sheffield Cleansing Committee recommending the purchase of a 2-ton Edison vehicle.

Included among other features is a list of the electric vehicles now in use and on order in Great Britain. The total is 570. This issue also contains a separate pamphlet containing notes prepared by the Electric Vehicle Committee for the guidance of those who have to make arrangements for charging battery vehicles.

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MOTOR TRAFFIC.

WORKING COSTS OF MOTOR LORRIES.

A RETURN COMPILED BY SHEFFIELD'S CITY SURVEYOR.

In the annual report of Mr. W. J. Hadfield, city surveyor of Sheffield, for the year ended March 25 last, the subjoined analysis is given of the cost of running six 5-ton motor lorries. The vehicles were impressed by the War Office in August, 1914. In order to avoid undue wear and tear, and to prolong the life of the vehicles, the lorries were never loaded to more than about 80 per cent. of their capacity, otherwise the cost per ton-mile might have been considerably reduced.

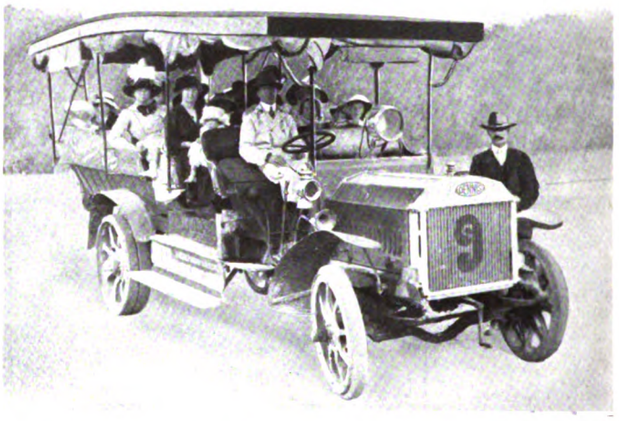
Mr. Hadfield states that leaving out of the question the three lorries last purchased, which had not needed tire renewals, there has been sufficient experience to demonstrate that each lorry, after allowing very full depreciation, is capable of saving at least £200 per annum compared with team labour. The loss of the six lorries therefore means a loss to the department of £1,200 per annum, and at present there is no prospect of replacing these, as the whole output of lorries suitable for the work is requisitioned for national purposes.

Dealing with the question whether the allowance for depreciation is adequate, the report states that one of the best answers is the fact that No. 1 lorry, which had been in the service of the Corporation for four years, had run over 30,000 miles, and was valued in the books at £282 (about two-fifths of its purchase price), was lately doing good service after nearly twelve months' wear and tear with the Expeditionary Force.

The department is now using several second-hand motor car chassis, which have been purchased and adapted for the work. It is not expected that these will be anything like so efficient as the lorries. Some of these second-hand chassis have been used in an experimental way, and it is hoped that the experience now being gained will enable propositions to be put forward after the war for the much wider use of motor traction on Corporation work. Three of the chassis have been fitted with ambulance bodies for the conveyance of wounded soldiers between the railway station and the hospitals.

DENNIS OMNIBUSES IN AUSTRALIA.

Appended is an illustration of one of a fleet of 12 Dennis vehicles which went out to the Townsville Motor Omnibus Company, Townsville, Australia, some years back, and have since then been operated with considerable success. The photograph was sent to Dennis Bros., of Guildford, by Mr. Sedgley, who sailed from England



18 months ago to take up the position of manager of the company on the retirement of Mr. Tice, who is now acting as Dennis agent in Townsville. Mr. Sedgley states that all the omnibuses are still running well and doing excellent work. He anticipates after the war a very considerable demand for Dennis vehicles in the Townsville district.

Motor No.	Date of First Journey	Original Cost.	Written off for Depreciation.	Book Value when taken over by War Office.	Miles Run	RUNNING COSTS. Wages.	Petrol, Oil, etc.	Tire Renewals.	Insurance and Repairs.	Running Cost per Mile.	Cost per Mile run including Depreciation.	Cost per Mile.	Total Costs including Depreciation.	Estimated Cost of same work by Horses	Saving.
		£ s. d.	£ s. d.	£ s. d.		£	£	£	£	d.	s. d.	d.	£	£	£
1	Dec. 15, 1910	706 15 0	424 17 11	281 17 1	30,484	329	457	172	296	9·87	1/1·22	6·25	1679	2545	866
2	May 14, 1912	693 5 0	259 10 6	433 14 6	17,966	199	220	96	170	9·15	1/0·62	5·80	945	1715	770
3	July 31, 1913	732 10 0	120 6 11	612 3 1	8,993	81	119	23	58	7·50	11·28	5·05	401	920	519
4	July 31, 1913	732 10 0	120 6 6	612 3 6	10,250	92	121	Nil.	54	5·30	9·05	3·94	387	1071	684
5	June 10, 1914	742 10 0	19 0 9	723 9 3	1,875	15	20	Nil.	37	9·23	11·63	5·59	91	160	69
6	June 10, 1914	742 10 0	19 0 9	723 9 3	2,058	17	20	Nil.	36	8·57	10·74	4·91	92	187	95
		£4350 0 0	£963 3 4	£3386 16 8	71,626	£733	£957	£313	£651	Average 8·82	Average 1/0·05	Average 5·55	£3595	£6598	£3003

Amount received from War Office, £3,590 3s. 1d. including small additions for accessories.

NOTE.—All the Motors ceased working for the Corporation on August 5, 1914.

* This low cost is accounted for by the fact that the lorry was transferred before the tires needed renewal.

MOTOR VEHICLES FOR MUNICIPALITIES.

FORMBY COUNCIL have invited tenders for the supply of a motor hose tender.

HENDON COUNCIL are negotiating for a loan for the purchase of a motor fire-engine.

ASHTON-UNDER-LYNE COUNCIL are considering the provision of a motor fire-engine.

WALLSEND-ON-TYNE COUNCIL have received the sanction of the Local Government Board to purchase a motor fire engine at £1,100.

BURY COUNCIL have accepted an offer by Messrs. Drake and Gorham to supply on trial an Edison accumulator street cleansing chassis.

TODMORDEN COUNCIL have resolved to provide the borough officials with a motor car, as horse traction is now found to be more costly than motor car traction.

LEEDS TRAMWAYS COMMITTEE, at the September meeting of the Corporation, were stated to be endeavouring to purchase a small motor chassis in order to provide means of conveyance for munition workers between Leeds and Shadwell.

GLASGOW COUNCIL'S representatives who attended a conference of sanitary inspectors held in London have issued a report stating that they are of opinion there is a promising future for electric vehicles, particularly for the collection of refuse.

SHEFFIELD ROADS COMMITTEE are considering the question of purchasing another motor sweeper. The machine now in use has replaced six horse sweepers at approximately the working cost of four, according to a report presented by the city surveyor.

BLACKPOOL COUNCIL'S cleansing superintendent estimates that the General Electric Vehicle Company's street watering van recently delivered is doing work equal to that of five of the discarded horsed vehicles. Besides its ordinary duties, the van assists in washing the tramway track and promenade at night.

PRESTON COUNCIL members recently witnessed a demonstration given by the fire brigade with a motor fire engine purchased from Messrs. Merryweather and Sons. Thirty seconds from starting the engine was throwing water to a height of 150 feet, the suction hose being dropped 27 ft. over Penwortham Bridge into the river. The machine carries a 40-gallon tank of water under the driver's seat in order to deal with small fires.

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MOTOR TRAFFIC.

WOMEN'S UNIFORM AT BARNSLEY.

The appended photograph shows the type of uniform adopted for women omnibus and tramcar conductors in the employ of Barnsley and District Electric Traction Company. The dress shown is the summer uniform made from Barnsley linen drill, which is washable, a very essential quality on the dusty roads traversed by the Barnsley omnibuses.

Mr. Walter E. Nicoll, the acting general manager, is to be complimented upon the head-dress he has selected. The pattern adopted is admitted to meet the requirements very satisfactorily, as it is extremely light, forms a complete covering for the hair from dust and rain, requires no hatpins, and has no projections to cause trouble in a crowded vehicle.

For the winter uniform navy serge is utilised.

HEAVY MOTORS AND ROAD DAMAGE.

In his annual report Mr. T. B. Goodyer, general manager of Croydon Corporation Tramways, says :—" In July it was announced that the Government hoped that there would be a Joint Committee, formed from both Houses, to inquire and report as to the law relating to the running of motor omnibuses and trolley vehicles under statutory powers and otherwise ; whether any amendment was necessary with respect to the control to be exercised by local authorities, and what contribution, if any, should be payable towards the cost of road maintenance. Owing to the war nothing further was done in the matter.

" In March it was officially announced that in view of the complaints as to the alleged excessive damage caused to roads by certain classes of heavy motors and locomotives the President of the Local Government Board had appointed a small expert committee to inquire into the sufficiency of the existing requirements with respect to the construction of these vehicles, including weights on wheels, widths of tires, diameter of wheels, etc. The terms of reference are :—' To consider the law and regulation as to the construction and use of road locomotives and heavy motor cars in Great Britain and to report what amendments, if any, are desirable.' "

Serviceable Uniform of Barnsley Omnibus and Car Conductors.

NEW RAILLESS ROUTES AT SWINTON.

Following inspection by the Board of Trade, the two sections of railless trolley routes added to the undertaking of Mexborough and Swinton Tramways Company were opened for traffic on August 31. One section extends from the junction of Swinton Road and High Street, Mexborough, to Manvers Main Colliery on the west, and the other from Mexborough toll bar to Elm Green, Conisborough, on the east. The cars, each of which seats 28 passengers, are equipped for running over the tramways through Mexborough, which connect the railless routes. A half-hourly service is being run, and it begins at 5.30 a.m. to meet the needs of the miners.

DEMANDS FOR MOTOR OMNIBUSES.—Rotherham Tramways Committee recommend the purchase of three motor omnibuses, and providing the arrangement can be completed, that the Town Clerk be instructed to make application to the Treasury for sanction to a loan not exceeding £3,000 for the purchase. Complaints of overcrowding of the vehicles of Birmingham and Midland Motor Omnibus Company having been made by Broomsgrove Council, the company have replied that the trouble will be remedied as time goes on and new omnibuses are delivered. The latest request received by Sheffield Tramways Committee for omnibus facilities relates to Eckington and Mosborough.

PETROL-ELECTRIC CARS FOR IRELAND.

The first of a number of petrol-electric cars ordered for Dublin and Blessington Steam Tramways Company has been supplied from the works of Messrs. Hurst, Nelson and Company, of Motherwell. The cars are being built to the design of Mr. J. P. Tierney, C.E., the managing director of the tramways, and they will each accommodate 75 passengers, besides hauling one of the existing steam cars as a trailer. With a view to running over the system of the Dublin United Tramways Company, the petrol-electric cars will be so fitted that the two motors can obtain current from the trolley wire.

A SOLID TIRE ASSOCIATION.—A committee has been formed from among representatives of solid tire manufacturers. Meetings are to be held on the first Tuesday in each month, at 3 p.m.

THE ASSOCIATION OF AUTOMOBILE ENGINEERS.—The first meeting of the Association will be held on Wednesday, November 10, when Mr. J. H. Dickenson will read a paper on " The Use and Abuse of Steel in Automobile Construction."

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MOTOR TRAFFIC.

MOTOR OMNIBUS COSTS.

HALIFAX CORPORATION.

Appended are statements of income and expenditure of additional Corporation motor omnibus undertakings for the year ended March 31, 1915.

	1914-15. Amount.	1914-15. Average per mile run.	1913-14 Amo'nt
EXPENDITURE.	£ s. d.	d.	£
To Traffic Expenses—			
Motormen and conductors' wages	717 18 8	2·555	707
Cleaning 'buses	52 7 7	·185	52
Licenses	15 4 0	·053	15
Uniforms and sundries	23 13 4	·086	32
Extra 'bus for one week ...	—	—	29
	809 3 7	2·879	835
To General Expenses—			
Third party and other insurance	103 19 6	·370	95
National insurance contributions	7 0 10	·025	6
Carriage and sundries	18 7 3	·068	41
Proportion of rent, rates, and management expenses ...	100 0 0	·356	50
	229 7 7	·819	192
To General Repairs and Maintenance			
Bodies	48 12 1	·173	57
Chassis, gearing, &c.	151 12 0	·541	101
Ignition	17 13 1	·064	23
Engine and water circulation ...	105 10 9	·376	73
Oiling and lubricating	74 3 9	·263	66
Lighting fittings	22 9 2	·078	20
Garage and various	52 17 8	·189	67
Tires	194 7 5	·690	641
	667 5 11	2·374	1,048
To petrol	564 3 8	2·007	561
To lighting of 'buses	10 3 0	·035	3
To interest on loan	—	—	84
	2,280 3 9	8·114	2,723
Balance to net revenue	215 6 8	·767	—
	£2,495 10 5	8·881	£2,723
INCOME.			
By Traffic Revenue —			
Passengers, Wainstalls section ...	1,410 16 4	—	1,412
,, Siddal section ...	1,063 5 10	—	1,116
Private omnibuses	2 15 0	—	4
Vouchers and tokens	13 17 4	—	15
Luggage and parcels	4 15 11	—	4
	2,495 10 5	8·881	2,551
By deficiency	—	—	172
	£2,495 10 5	8·881	£2,723

NET REVENUE ACCOUNT.

To Balance carried down	£523 7 3	By Balance as per abstract, March 31, 1914 ...	£308 0 7
		By Balance from revenue account	215 6 8
	£523 7 3		£523 7 3
		By Balance brought down	£523 7 3

CAPITAL ACCOUNT.

To 3 motor omnibuses and equipment	£2,510 7 9	By mortgage debt redeemed ...	£2,510 7 9

BALANCE SHEET AT MARCH 31, 1915.

Liabilities.		*Assets and Capital Outlay.*	
CAPITAL ACCOUNT.			
Mortgage debt redeemed ...	£186 7 5	Motor omnibuses and equipment	£2,510 7 9
Contribution from Tramways surplus account ...	2,324 0 4		
	£2,510 7 9		£2,510 7 9
REVENUE ACCOUNT.			
Sundry creditors	£61 8 4	Stock of tickets ...	£5 16 11
Net revenue account	523 7 3	Insurance premiums unexpired ...	55 14 7
		Treasurer, balance in bank £589 16 1	
		Less— Cheques and transfers not cleared 66 12 0	523 4 1
	£3,095 3 4		£3,095 3 4

WOLVERHAMPTON CORPORATION MOTOR CHARS-A-BANCS.

	1914-15. Amount.	1914-15. Av'ge per mile run.	1913-14. Am'nt	1913-14. Av'ge per mile run.
EXPENDITURE.	£ s. d.	d.	£	d.
Operating Costs—				
Petrol	739 8 0	1·555	338	1·671
Wages—Drivers and conductors ...	893 10 5	1·880	420	2·074
,, Oilers and Cleaners	138 8 10	·291	50	·250
War bonus	6 6 0	·013	—	—
Oil, grease, and sundries ...	71 19 9	·152	31	·154
Tickets, waybills, etc. ...	18 8 8	·039	6	·029
Uniforms	27 0 0	·057	13	·067
Miscellaneous	14 9 7	·030	6	·029
	1,909 11 3	4·017	864	4·274
General Charges—				
Licenses	22 7 0	·047	11	·054
Insurances	92 4 4	·194	45	·224
Printing and Stationery ...	1 2 1	·002	4	·018
Miscellaneous	5 12 7	·012	4	·021
	121 6 0	·255	64	·317
Maintenance, Repairs, etc.—				
Chassis	280 16 5	·590	187	·926
Bodies	59 19 9	·126	82	·404
Tires	313 9 7	·660	243	1·202
Depreciation (net)* ...	178 0 6	·374	235	1·164
	832 6 3	1·750	747	3·696
Bank Interest	75 19 7	·160	30	·148
	2,939 3 1	6·182	1,705	8·435
Balance to net revenue ...	1,554 3 6	3·269	366	1·809
	£4,493 6 7	9·451	£2,071	10·244
INCOME.				
Traffic Receipts	£4,493 6 7	9·451	£2,071	10·244

The above figures do not include any proportion of General Management expenses, rents, rates, etc.

* After crediting this account with surplus after sales.

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MOTOR TRAFFIC.

MANCHESTER CORPORATION MOTOR OMNIBUSES.

The following is the statement of the working of the motor omnibuses of Manchester Corporation Tramways Department for the year ended March 31, 1915 :—

EXPENDITURE.

	Per mile. d.	£ s. d.
Traffic Expenses—		
Superintendence and other traffic wages...	·220	147 7 6
Wages of drivers and guards	2·289	1,533 11 8
Bonuses and sick pay	·062	41 6 0
Cleaning and oiling	·313	209 6 11
Depot expenses	·142	95 2 6
Ticket check	·177	118 11 5
Uniforms	·099	66 6 5
Licenses and sundries	·087	58 7 5
	3·389	2,269 19 10
General Expenses—		
Salaries and wages—Administration ...	·156	104 10 1
Rates on depots	·072	48 4 8
Printing and stationery	·022	14 14 9
Fuel, light, and water	·014	9 7 6
Compensation	·110	73 13 10
Insurance	·014	9 7 7
	·388	259 18 5
Repairs and Maintenance—		
Tires for own vehicles	·658	441 2 1
Chassis	·685	458 11 0
Bodies	·115	77 4 5
Buildings and machinery	·059	39 10 6
	1·517	1,016 8 0
Hire of Chassis—		
Chassis hired for portion of year to replace vehicles impressed by the War Office ...	·297	199 0 3
Power expenses—Petrol	1·776	1,189 16 0
Total working expenses	7·367	£4,935 2 6
Depreciation—		
On vehicles owned by the Corporation ...	·703	470 17 8
	8·070	£5,406 0 2
Balance carried to tramways account ...	1,174	786 10 4
	9·244	£6,192 10 6
Traffic revenue	9·244	£6,192 10 6

Number of miles run	160,775
Passengers carried	1,186,569

CALTHORPE COMPANY'S HUGE PROFIT.

The accounts of the Calthorpe Motor Company for the year ended July 31 showed a divisible balance of £20,086 after providing for debenture interest. A final dividend of 20 per cent. was proposed on the ordinary shares, making 30 per cent. for the twelve months, adding £5,000 to the reserve, and carrying forward £7,748. Mr. W. Hill (chairman), at the annual meeting on September 21, said the profit represented 75 per cent. on the paid-up capital, and an increase of 71 per cent. on the previous year. This profit had been made on sales of cars, and were not in any way due to the war. Such figures appearing in a mid-war balance sheet were truly phenomenal. They had on their books more orders than they could possibly execute under existing conditions. Three months ago they obtained important Government orders of a nature he was not at liberty to disclose, and also orders from the Governments of our Allies. New plant and machinery had been added to deal with those orders, the work being entirely novel to them.

MOTOR TRANSPORT IN THE ITALIAN ARMY.—Only cars of Italian make are being used in the war against Austria by the Italian army, the output of the Italian factories being quite adequate. It was not until April last that the Government prohibited the export of Italian cars, and now a number of the makers are devoting part of their attention to the manufacture of war material.

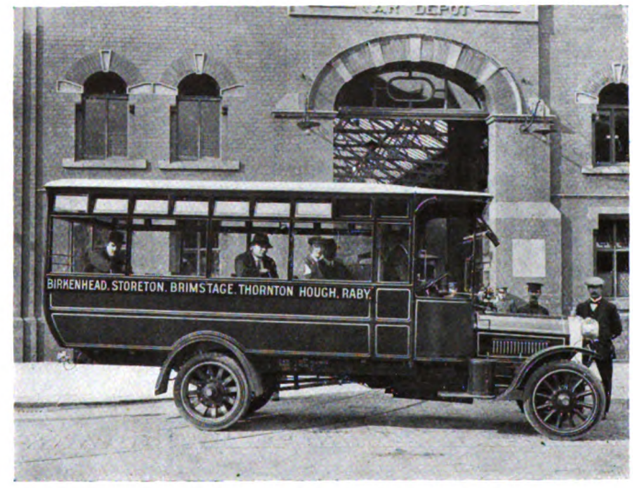
"STAR" OMNIBUS CHASSIS.

An illustration is appended of a 50-cwt. "Star" single-deck omnibus that the Star Motor Works, Wolverhampton, have supplied to Sir William Lever, Bart., for service in Birkenhead. Other "Star" omnibuses are now on order for service in the provinces and in London, following the successful running of the company's public passenger vehicles, both in this country and in the Colonies. A similar chassis has also given excellent results when used for char-a-bancs work. Cars of the latter type are built to carry up to 30 persons, and can be provided with interchangeable char-a-bancs and commercial bodies.

The vehicle depicted on this page is well adapted for local authorities who require to cater for urban or outlying localities at a moderate capital outlay. The makers supply a table of running costs worked out on the average life of a vehicle kept in good running order, for distances ranging from 40 to 100 miles.

Notwithstanding that the increased cost of labour and material at this period necessitate an addition of 10 per cent. to the catalogue prices, the total cost of a "Star" omnibus is still such as to render it an argument in favour of purchase.

The 50-cwt. chassis of the Birkenhead vehicle is admirably adapted for omnibus and char-a-bancs work, being exceptionally well sprung. The whole of the transmission, including the road wheels, is mounted on Timken roller bearings, making riding very easy. The frame is of pressed steel, deep section, the engine and gear box being carried on a separate underframe. The rear axle is of the double reduction type live axle, specially designed to carry heavy loads, the entire weight being taken on the tubular portion, leaving the shafts free for driving. Chain drive can be had if desired. From the front axle, which is specially strong in section, a good lock can be obtained, enabling the car to turn in a very small space. Three powerful brakes are fitted.



"Star" Omnibus at Birkenhead.

Seating accommodation is provided for 22 passengers, the body being also made by the Star Engineering Company, Limited. The seats are dual, with a centre passage and one long seat the full width of the body at the rear. The back of the seats are slat pattern, the seats being spring cushioned, covered with the best leather hide and stuffed with horse hair.

PRICES PAID TO CONTROLLED WORKS.

At the annual meeting of Singer and Company, at Coventry, on September 9, the chairman (Mr. A. E. Jagger) said that the profits for the past year were £8,000 less than in the preceding year, due to their being on munition work and the War Office paying less for the cars they required than would have been given by the general public. Singers were a controlled establishment, and he hoped that the authorities would see ultimately that their profits did not really suffer through being engaged on Government work. The meeting voted £1,000 additional remuneration to the directors.

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MOTOR TRAFFIC.

ADDITION TO LEEDS RAILLESS SERVICE.

Members of Leeds and Bradford Tramways Committee attended the opening on September 7 of the railless trolley extension of the Leeds tramways from Guiseley to Otley. Its length is three miles and a furlong. Mr. H. Duncan, chairman of Otley Council, referred to the importance of the linking-up of rural townships with great cities. He trusted that the system would be an unqualified success, but they must not be unmindful of three essentials—an efficient service, an appreciative public, and proper road maintenance. They were not afraid that the extension would result in Leeds swallowing up Otley, but if ever overtures were made in that direction they would be resisted most strenuously. Leeds Tramways Committee were represented by Messrs. J. S. Hinchcliffe, G. H. Pearson, A. Masser, and C. G. Gibson; Bradford Tramways Committee by Mr. E. Priestley (chairman); Leeds tramways department by Messrs. J. B. Hamilton (general manager), N. G. Morrison, and T. Winn; and Bradford tramways department by Mr. C. J. Spencer (general manager). The chairman of Bradford Tramways Committee announced that they were looking forward to extending their service to Otley, *via* Shipley, and joining hands at Guiseley.

MOTOR TRAFFIC NOTES.

Motor Cars for Tramway Departments.—Two petrol motor cars, two motor tower wagons, and a motor lorry are included in the equipment of Salford tramways department.

New Warwickshire Omnibus Service.—Kiveton Rural Council have approved of the proposal of Mr. J. Darrington to start a motor omnibus service between Kiveton Park and Aston.

Power to Run Omnibuses at Lincoln.—The Lincoln Corporation Act, 1915, includes clauses giving authority to purchase and run motor omnibuses, and to extend the electricity works.

British Motor Cab Company.—The net profits for the year ended March 31 were £15,884, and the sum brought forward was increased to £17,499, which it is proposed to carry to the new account.

Motor Cars for Indian Railways.—The Eastern Bengal State Railway and the Assam-Bengal Railway are running motor cars for the conveyance of passengers, luggage, and goods in several outlying districts.

Enlistment in the Mechanical Transport Corps.—The experience required of motor car and petrol lorry drivers for enlistment in the mechanical transport of the Army Service Corps is now one year of regular driving.

Irish Gift of Twenty-two Ambulances.—The Lord Mayor of Belfast, on September 21, on behalf of the subscribers, presented the Ulster Division of the King's new army with 22 motor ambulances which have cost over £10,000.

To Economise Petrol on Omnibuses.—Warrington Tramways Committee have offered the drivers of the department's motor omnibuses a bonus of 1s. when they average six miles to the gallon of petrol, and an additional bonus of 1s. when the average is 6½ and over.

Scarcity of Omnibuses at Dunfermline.—Complaint was made at a meeting of Dunfermline Council, on September 13, that the motor omnibuses were overcrowded. The Provost observed that the overcrowding might be dangerous, as an omnibus was recently upset.

Battery Traction for War Service.—Storage battery cars are being run by the Germans in Belgium on the short lengths of railways which lead up to the trenches behind their lines. The cars are being run singly to remove the wounded and bring up supplies.

Traffic Inducement in London.—A recent folder issued by the London General Omnibus Company gives the times of the first and last omnibuses to rural and historic places of attraction. The stations are also named at which passengers can change to the Underground Railways.

Electric Vehicle Trials in Zurich.—The electric supply authority at Zurich, in view of a shortage of petrol, recently instituted trials of battery vehicles. The hilly route had a total rise of 220 ft. A journey of 74 miles was performed in 6¾ hours, the vehicles carrying a load of 1½ tons.

Tramway Company's Char-a-Bancs.—The Gosport and Fareham Tramways Company not long ago decided to meet a public want by obtaining a motor char-a-bancs. A Thorneycroft machine of 40 h.p., seating 28 persons, was purchased, and put into touring service in the Portsmouth district. Its working has given great satisfaction to the management, and the vehicle has become very popular among residents and visitors.

London Motor Omnibuses.—At the end of August, 1914, there were 3,319 motor omnibuses licensed in the Metropolis. On the same date in the present year the total was 2,221. The reduction of 1,098 is due to impressment for military service. Sixteen vehicles were added during the month of August.

Road Motors in Lieu of a Railway.—Replying to an agricultural deputation who asked for a 12-mile extension of a railway to Marburg, Hillside, and Lockrose, the Railway Minister to the Queensland Government suggested the establishment of a motor lorry service such as exists in some other districts.

Automobile Dust Carts for Petrograd.—With the object of improving and reorganising the rolling stock of the Petrograd sanitary department, it has been decided to acquire automobile dust carts for the removal of the town waste. It is proposed to spend 10,000 roubles on the purchase of these carts.

Rail Petrol Motors for Military Use.—An appeal was made recently for men to enlist, in the railway transport sections of the Royal Engineers, who had had good experience in connection with internal-combustion engines. The engines they will be required to work are moderately high-speed petrol sets up to 180 b.h.p.

An Opening at Sandgate.—In August, 1914, the South Eastern and Chatham Railway Company discontinued their horse tramways at Sandgate. At a recent meeting of the Urban Council a member stated that the company had lost thousands of pounds by not working the line. The Council requested the clerk to ask the general manager to consider the question of using mechanical traction.

Perth Corporation's Omnibuses.—Owing to the great demand for the motor omnibus service between Perth and the military camp at the Bridge of Earn, the Perth Corporation decided to secure an additional vehicle, if it is possible to obtain one. Unfortunately the scrambling for seats has led to the issue of an order by the military authorities that Territorials are to return to camp on foot.

Bradford Corporation Motor Garage.—In his report for the year 1914-15, the general manager of Bradford Corporation Tramways states that during the year a report was presented to the tramways committee suggesting considerable reforms in the motor garage department. The matter was, however, abandoned at the outbreak of war, and, he presumes, will be left over until hostilities cease.

General Motors Company.—The net profits of the General Motors Company for the year ended July 31 were $14,926,322, an increase of $6,978,909 compared with the previous year. The surplus after the payment of preferred dividends was $13,408,839, an increase of $7,207,784, and the total accrued profits were $19,985,160. A dividend of 50 per cent. is proposed on the common stock, leaving $11,731,769 unappropriated. The sales were $94,424,841, an increase of $9,051,538.

Resilient Material for Roads.—As the result of the attendance of members of Cardiff Works Committee with the city surveyor at the annual conference of the County Councils' Association, and of their inspection of roads at Hornsey, the deputation on September 16 reported to the committee on the use of mexphalte for road construction. It would provide a resilient surface, and also find an outlet for using some of the clinker produced at the sewage works. The report was referred to a sub-committee.

Double Utility of South African Railway Motor Plant.—In the annual report of the general manager of the South African Government Railways it is stated that practically the whole of the motor vehicles belonging to the department were engaged and operated as a branch of the South African Service Corps during the campaign that ended in the occupation of the German colony. All the department's motor drivers volunteered for active service. The department also constructed and manned five armoured trains.

Praise for the Mechanical Transport Corps.—In his despatch dealing with the operations of the British Expeditionary Force in France and Flanders during the three months ended on June 30, Field Marshal Sir John French refers in terms of high praise to the work of the mechanical transport department of the Army Service Corps. In the course of the second battle of Ypres their work was carried on for five or six weeks on roads which were continually searched by hostile heavy artillery during the day and night.

Ungainly Appearance of Omnibuses.—Referring to complaints as to the noise of the tramcars and the ungainly appearance of the motor omnibuses, which were made at a meeting of Middlesbrough Hackney Carriage Committee, on September 21, Alderman Mattison objected to the Council adopting a pin-pricking policy against the tramways company. Considering the usefulness of the omnibuses to the public the Council were taking up an antiquated attitude which reminded him of the foolish opposition to railways when they were inaugurated. The committee took no action.

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THE Tramway & Railway World
WITH MOTOR TRAFFIC SECTION

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LONDON AND SOUTH WESTERN RAILWAY ELECTRIFICATION.

EQUIPMENT OF THE POWER STATION, TRAINS AND SUBURBAN ROUTES.

On Monday, October 25, electric trains began running in regular service on the London and South Western Railway between the Waterloo terminus and Wimbledon, *via* East Putney, a distance of about eight miles. Before long electric traction will be in use over the whole of the company's suburban lines. Among schemes for the electrifying of steam railways, this is one of the most important which has come to fruition in this country. It embodies, moreover, some novel features of much interest to those concerned in electric traction; it is accordingly worthy of attention in detail.

Fig. 1.—General View of Wimbledon Electric Power Station and Train Sheds—London and South Western Railway.
(The Road over the Concrete Viaduct to the Coal Bunkers passes between the Chimneys. The Main Line is seen on the right.)

London was a pioneer in the matter of underground electric railways, but it was not till 1905 that steam lines running in the open through the outer suburbs were converted to the electric system. These routes belong to the Metropolitan District Railway, and formed part of the scheme for electrifying the whole of that company's system. About the same time part of the suburban lines of the Metropolitan Railway were converted. The Great Western Railway Company's Hammersmith and City line, part of which is in the open, began working electrically at the end of 1906. In December, 1909, the great scheme of electrification of the London, Brighton and South Coast Railway was inaugurated, and since then additional sections of the suburban lines of that company have been converted to electric traction. The Brighton Company alone uses the single-phase alternating-current system with overhead wire conductors. All the others employ direct-current traction with third-rail conductors. In 1912 the London and South Western Company made public the particulars of their scheme of suburban electrification, and about the same time the London and North Western Company put forward their proposals. The

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latter are, however, not so far advanced as the former, as they involve the construction of an entirely new railway for most of the distance between Euston and Watford, measuring some 16 miles of route, and running alongside the main line. The South Western Company's scheme required only a short length of widening and the construction of one fly-over junction.

The entire electrification proposals of the London and South Western Company cover a route length of 97 miles, with an equivalent of 250 miles of single track (Fig. 2). This comprehensive scheme was divided

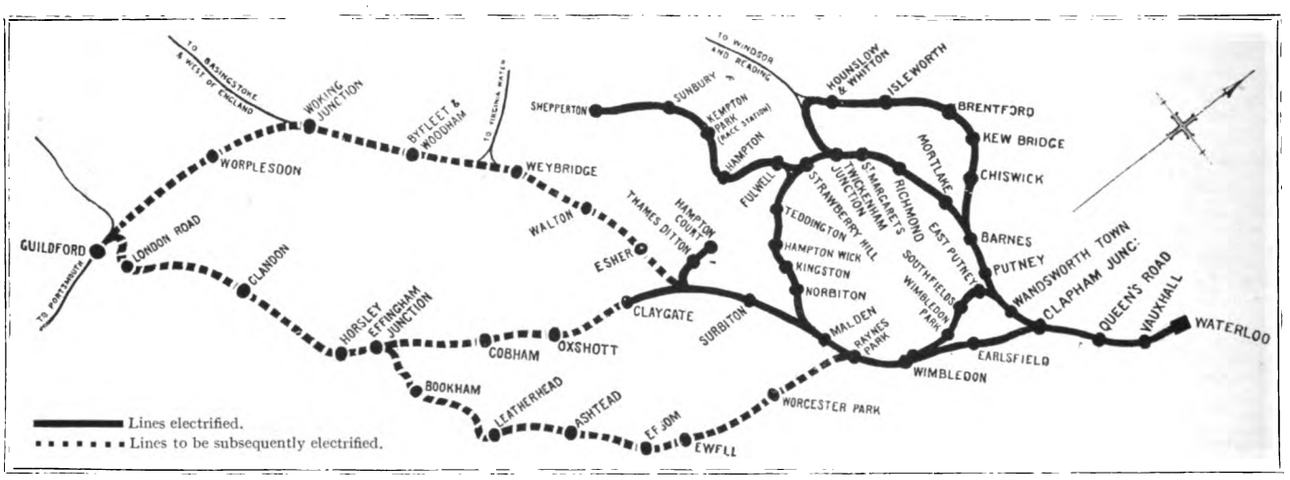

Fig 2.—Outline Map of Electrification Scheme of the London and South Western Railway.

into two sections, one to be proceeded with immediately, and the other to be taken in hand subsequently. The former, which is now practically complete, extends to 47 miles of route, embracing no less than 150 miles of single track. The second section covers 50 miles of route, i.e., 100 miles of single track. The lines which have now been electrified are the circular route from Waterloo to Clapham Junction and thence *via* Wimbledon, Kingston, Twickenham, and Richmond, returning to Clapham Junction and Waterloo; the Hounslow loop line; and the Hampton Court, Claygate, and Shepperton branches. The second section, when it comes to be taken in hand, will embrace all the company's lines as far to the south-west as Guildford. The map of both sections is shown in Fig. 2, and in Fig. 3 is given the lines included in the first section which are either in operation or on which work is now proceeding.

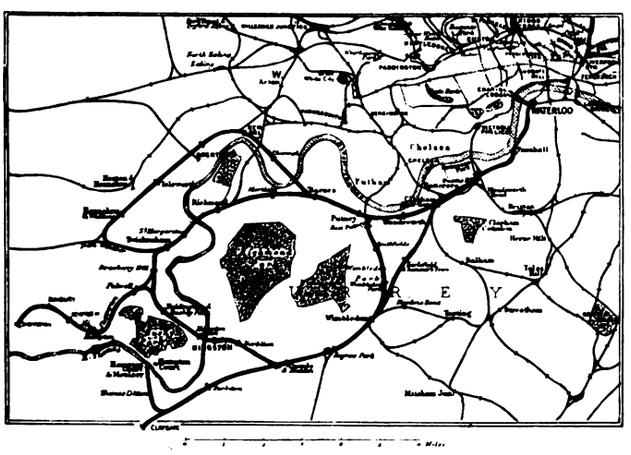

Fig. 3.—Electric Lines First Section.

There were both general and special reasons for the railway company undertaking the work of electrification. The former was the increasing conviction of the necessity for providing for the rapidly-growing and popular resorts in the part of the Thames valley served by the company a more frequent and rapid service of trains than was practicable so long as steam locomotives were used. There can be no doubt that it would be possible with steam traction to provide better suburban services than have been given, but the question of expense had to be reckoned with. Electricity on the other hand would allow of much more frequent services and higher train speeds without any prohibitive capital cost and with a reduction in working expenses per train-mile. As to special reasons, the railway company could see the Brighton Company rapidly extending the use of electric traction over suburban lines which, though not competitive, were sufficiently near at hand to enable the local travelling public to draw comparisons not favourable to steam traction. The same influence was at work through the speed and frequency of service on the electric lines of the Metropolitan District Railway, which at Putney and Wimbledon come in actual touch with the South Western Company's lines. Finally, there was the ever-growing competition of motor omnibuses, which year by year are extending their services farther afield from the Metropolis. Thus electric traction it had to be, and electric traction it is on a comprehensive and very excellent scheme. Several results are bound to follow. One is a great development of the districts concerned for residential purposes. This brings with it a corresponding increase of season-ticket traffic. In the third place, holiday traffic to such places as Richmond Park, Bushey Park, and other popular resorts will be greatly encouraged. The "Kingston roundabout," which encircles Richmond Park and Wimbledon Common, will have a new service, greatly improved in speed and frequency. Lastly, if past experience of electrification of city and suburban railways is not reversed, the railway company will find their net revenue increased to such an extent as will far more than compensate for the added capital expenditure.

It was in December, 1912, that the directors of the railway company finally determined to proceed with the scheme of electrification. After a careful and exhaustive study made by the engineers of the company of all systems in commercial use, it was decided to adopt direct current with a pressure of 600 volts at the conductor rail. It was also determined that the company should provide its own electric generating station, as most of the electrified railways in England have done, instead of purchasing energy from an

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electric supply company. Work was begun in the summer of 1913, and in spite of delays due to the outbreak of the war, it has now been brought to a successful conclusion.

The Power Station.

The electric generating station has been erected on a piece of land closely adjoining the main line of the railway at Durnsford Road, Wimbledon. Immediately adjacent extensive car sheds and repair shops have been erected. The site is well situated as regards the distribution of electricity to the company's suburban lines. The striking feature, on a first glance over the premises, is that it has been found possible to dispense with a coal and ash conveyor. The building is adjacent to the River Wandle, from which water is taken for condensing purposes. The ground slopes gradually towards the power-house and the river, and thus it was found possible to discharge the coal from railway wagons directly into the overhead bunkers of the boiler house. A junction was formed with the main line near the point where it passes under Durnsford Road bridge, and the short branch railway is carried on a reinforced concrete viaduct which leads into the upper part of the boiler house above the coal bunkers. This viaduct can be seen in Fig. 1. It forms part of a coal siding from the South Western Railway to the power station. It is constructed for a distance of 400 ft. with an open decking, through which coal is shot, the remaining 100 ft. with a closed deck is constructed on a curve to meet the steel span of the viaduct immediately adjacent to the boiler house. The track is laid at a general incline of 1 in 42, and is carried on main beams, which are arched and supported at intervals by framed trestles. The trestles, or "A" frames, throughout are at 25 ft. centres, the continuity of the main beams being broken at four points, and cast-iron sliding plates inserted at the bearings to provide for contraction and expansion. At the lower end of the viaduct, next to the earth embankment which runs between the viaduct and the main line embankment, a retaining wall of the "L" type is provided.

The total length of the retaining wall is 78 ft., and the horizontal slab forming the base is 9 ft. wide for a length of 20 ft. in the middle portion tapering to 2 ft. wide at the extreme ends, and is 7 in. thick. The vertical slab, also 7 in. thick, is 18 ft. high for the middle portion, diminishing to 3 ft. at the extreme ends, and is strengthened by buttresses at 8 ft. centres. The base of the buttresses extends to the back of the horizontal slab, whilst the thickness of the buttress is only 6 in. Running along the top of the wall for the centre 20 ft. is a coping beam 19 in. wide, 10 in. deep, supported by two columns 19 in. by 14 in., which beam in turn supports the two main girders in the end span of the viaduct.

The trestles (20 in all) are each built up of two columns raking towards the top and tied horizontally at the bottom and top as well as at the centre, all ties having ample brackets to ensure rigidity. The lowest trestle is 14 ft. 7 in. high over all, and the one next to the steel span 32 ft. 11 in. over all; the columns in the former are 11 ft. apart centre to centre at the base and in the latter 16 ft., the top of all the trestles being arranged directly to support the main longitudinal bearers carrying the rails, which are 5 ft. apart centre to centre. The leading dimensions of the trestles are as follow:—Size of cap to each column, 2 ft. 8 in. by 3 ft.; size of columns, 16 in. by 22 in., and 18 in. by 24 in.; size of base to each column, 7 ft. by 3 ft. 6 in., and 8 ft. by 4 ft.; centre horizontal struts, 2 ft. deep by 6 ft. thick. The two different sections given refer to the high and low trestles; the sizes of the trestles at the expansion joints are increased slightly. The 6 to 1 concrete foundation slabs under the ferro-concrete bases are 18 in. thick generally. The main longitudinal beams at 5 ft. centres carrying the rails are arched, being 3 ft. 9 in. deep at the centre of the span and 5 ft. 3 in. at the haunches, 10 in. wide with a flange at the top, 2 ft. 6 in. wide and 7 in. thick to carry the live rail in addition to the main rails.

A gangway, 18 in. wide, is provided on each side of the open portion of the viaduct, supported by cantilevers from the trestles and main beams at every 6 ft. The cantilevers are 6 in. thick, 24 in. deep at the inner end, and 12 in. deep under gangway. The two openings on either side of the track through which the coal is shot are 3 ft. 6 in. wide, making the overall width of the viaduct 18 ft. 6 in. Heavy removable steel gratings to run the whole length are provided for the openings. The deck of the curved portion of the viaduct is 6 in. thick, and is supported by four main arched beams each 9 in. wide, 3 ft. deep, below flooring at the centre, and 4 ft. 9 in. at the haunches, the heads of the trestles being made strong enough to carry in cantilever the two outer beams. A 9 in. by 6 in. curb is provided on each side to retain the ballast on which the sleepers and track is laid. The sleepers on the open portion of the viaduct are laid longitudinally, directly on to the main arched beams, ferro-concrete lugs on the flange top being provided at about 6 ft. centres, between which the sleepers are wedged, timber cross struts being used to enable the track to be secured in this way. The structure has been tested under the engineers' supervision with the stipulated dead and live loads with very satisfactory results. Approximately 550 cubic yards of concrete and 65 tons of steel were used in the construction of the ferro-concrete work, which is in accordance with the Hennebique system, the consulting engineers being Messrs. L. G. Mouchel and Partners, 38, Victoria Street, S.W. The contractors for the viaduct, including the rail track, were Messrs. Holloway Brothers (London), Limited.

The reserve coal storage space below the viaduct has a capacity of about 10,000 tons.

The power-station building (Figs. 1 and 13) is of brick, with the boiler house running parallel to the turbine house. There are two chimneys, each 230 ft. high above ground level, with an internal diameter of 13 ft. 6 in. at the top. They are built of brick on the Custodis principle.

Boiler House.—The boiler house is 237 ft. long by 130 ft. wide, and it contains 16 Babcock and Wilcox water-tube boilers in two ranges of eight each, with the firing floor between the rows (Figs. 4, 5, and 6). Each boiler has a normal evaporation of over 20,000 lb. of water per hour. Steam is delivered from the boilers at a pressure of 200 lb. per square inch, with a superheat of 200 deg. Fahr. The heating surface per boiler is 5,760 sq. ft., and a grate area of 123 sq. ft. Green's economisers are used for heating the feed water, and compressed air is employed for cleaning the tubes. Feed water is derived from the public supply mains, and is softened and purified by a Boby treating and filtering apparatus capable of dealing with 100 gallons per minute. This water is stored in a tank running the whole length of the roof of the switch-gear bay of the building, and having a capacity of 110,000 gallons. The make-up water abstracted is passed through a Lea recorder, thence through the turbine oil coolers, and finally into the hot wells.

A special feature of the boilers is that, instead of having brick setting only, they are cased in iron throughout with fire-brick lining, so as to make it impossible for air to percolate into the flues.

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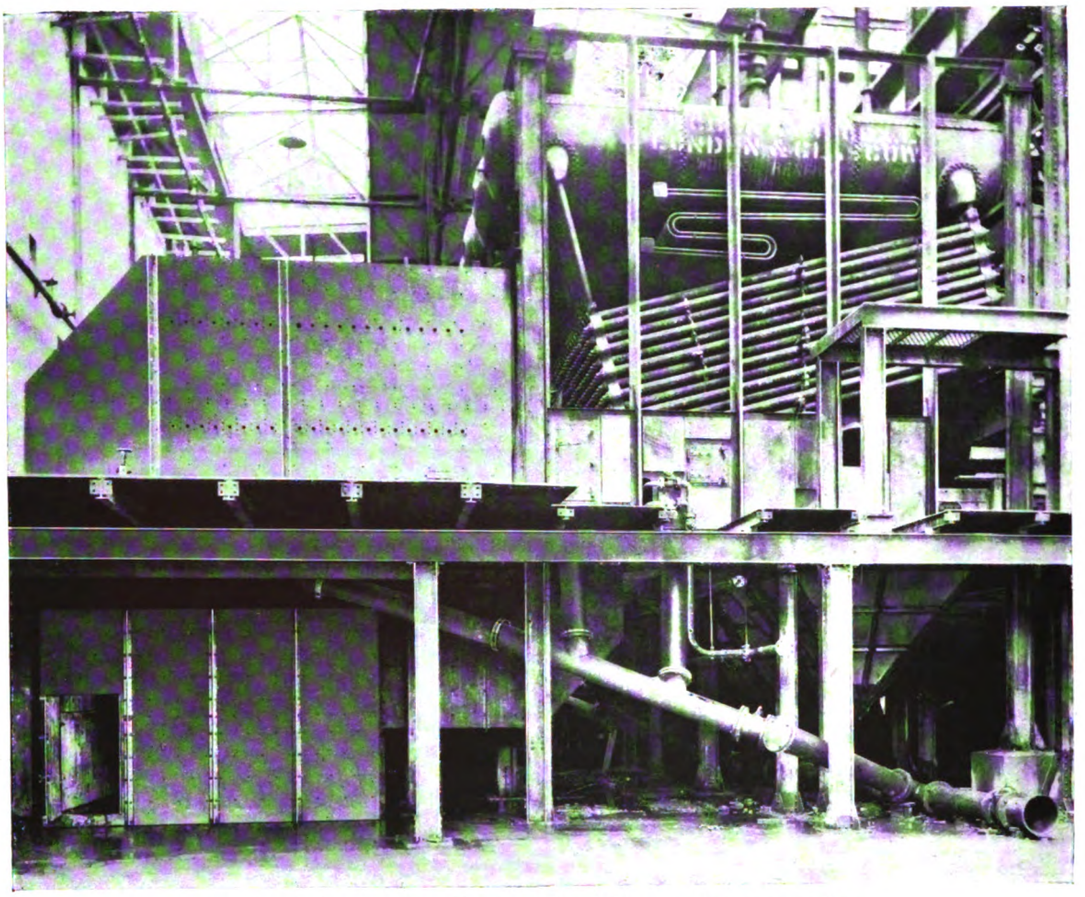

Fig. 4.—Side Elevation of one of the Boilers under construction.
(Showing Ash and Soot Suction Pipes under Boiler.)

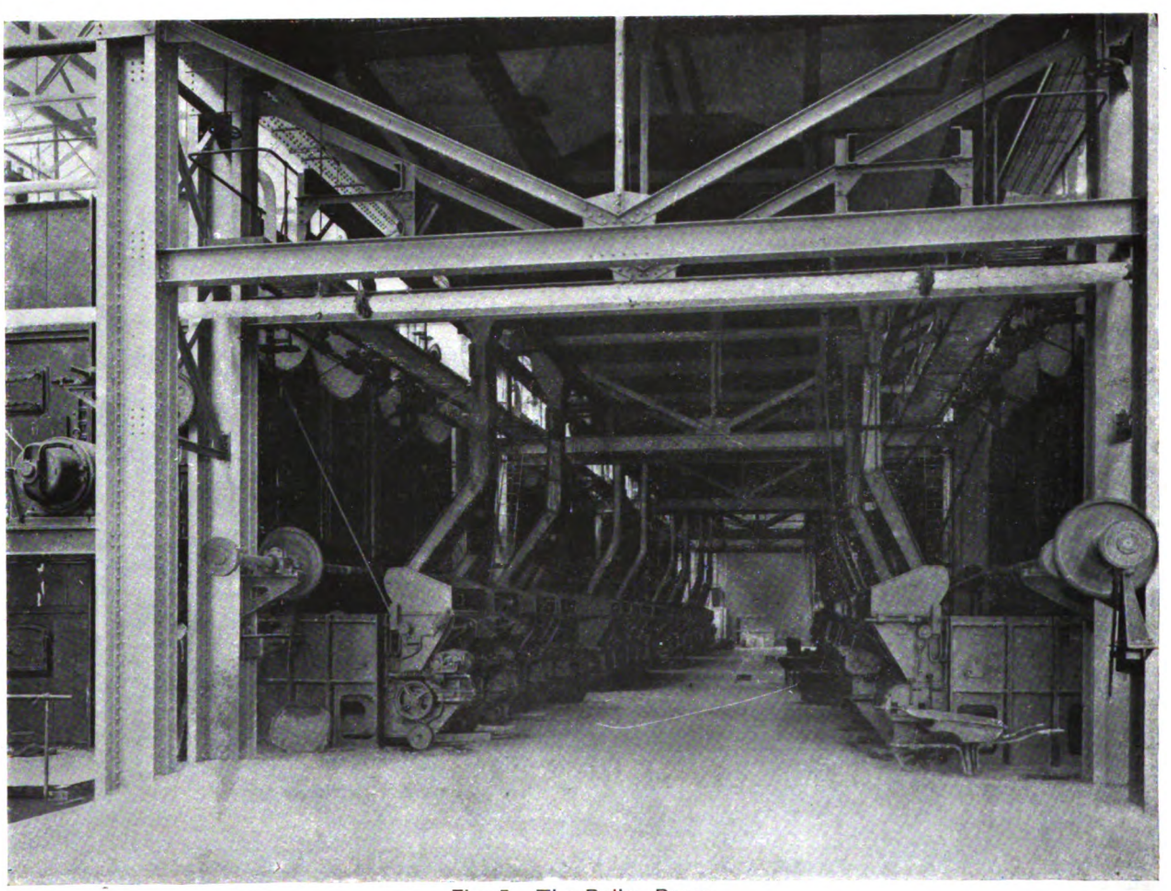

Fig. 5.—The Boiler Room.
(View on the Firing Floor, showing Two Ranges of Eight Boilers each and Chutes from Coal Bunkers Overhead.)

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The coal bunkers above the boilers are constructed of reinforced concrete, and have a capacity of about 1,400 tons. Fig. 6 shows a railway wagon on the floor above the bunkers, and one of the openings through which the coal is dropped into these receptacles. It afterwards descends in chutes to the mechanical stokers in the usual way.

Fig. 6.—Delivering Coal to the Bunkers above the Boilers.

Suction Ash Plant.—An interesting feature is the suction plant for handling the ashes, of a type that has so far only been installed in a few power stations. It is of the design of Babcock and Wilcox, Limited, and several advantages are claimed for it. Among these are :—(1) The healthier conditions under which the operator works ; (2) the removal of ash and clinker

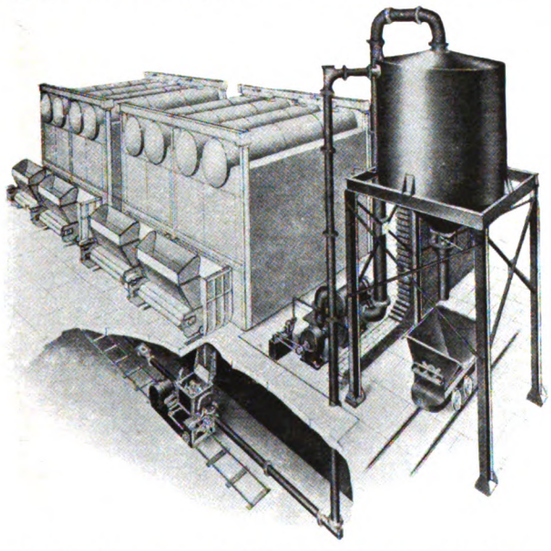

Fig. 7.—Diagrammatic View of a Suction Ash Plant.

without dust ; (3) one labourer is able to dispose of from 10 to 12 tons of ash from the furnaces to the ash-tip per hour ; (4) low cost of upkeep, and facility for repair ; (5) ease of manipulation ; and (6) that the appliance, like the automatic coal conveyor, is an additional means of securing the continuous running of steam plant. The plant consists primarily of a clinker breaker, a conveyor pipe, an ash receiver, and an exhauster. The clinker breaker runs on rails in the basement immediately under the ash chute doors. The ash and clinker fall from the chute into the breaker, in which the clinker is reduced to small pieces with a maximum size of three-inch cubes. The ash and broken clinker are then sucked through the conveying pipe into the receiver, the hot ashes being quenched before entering the latter. From the receiver the ashes are dropped into railway wagons on a siding provided for the purpose.

The general arrangement is shown diagramatically in Fig. 7, while Fig. 4 is a view of the plant as erected at the station. A view of the breaker under one of the ash chutes or hoppers is given in Fig. 9, where the cover, which is removed to let the ash fall out, may be seen. Fig. 10 shows the exhauster, motor,

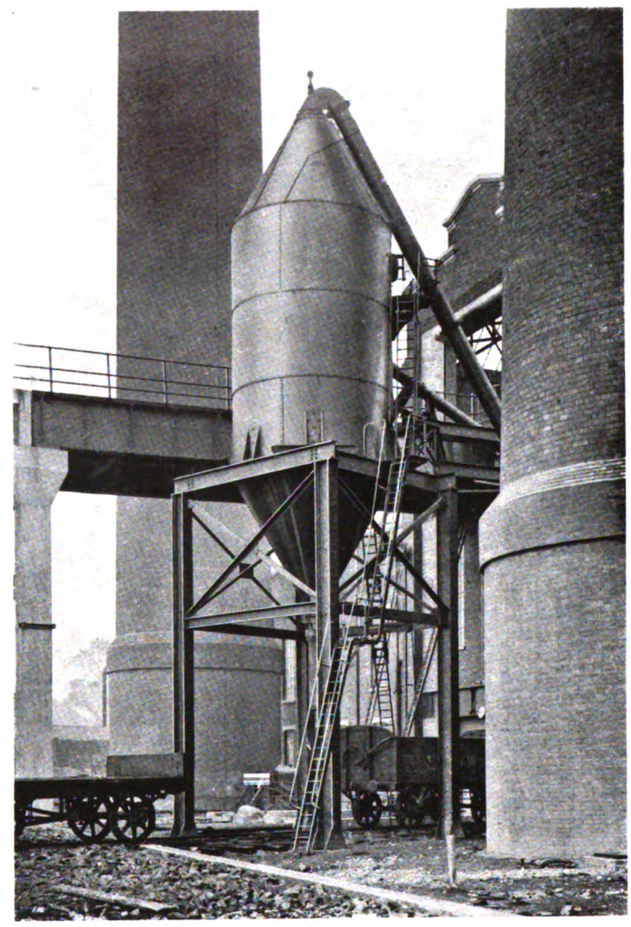

Fig. 8.—Suction Ash Receiver at Wimbledon Station.

and dust catcher with connecting piping. The receiver, which is placed outside the building, is shown in Fig. 8.

Referring to Fig. 4, the uncased boiler is shown on the upper floor to the right, and the economiser to the left. The open end of the suction pipe, which runs parallel to the track for the breaker, may be seen at the bottom right-hand corner. The air is sucked in at the open end, and carries away the ash which is entering the pipe by any aperture open. There is an aperture under each ash chute, and normally it is closed by a cast-iron plug. Only one aperture is opened at a time. The apparatus is also used for sucking soot from the economiser and the second and third divisions of the boiler. The soot pipes leading from these down to the main suction pipe are seen in the figure. When this work is being carried on the free end of the suction

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pipe has to be blocked up. A branch of the suction pipe is taken to the foot of the main chimney, so that the soot is collected there and afterwards removed. While the breaker is operated by a motor, the actual traversing of the apparatus along its rail from hopper to hopper is done by hand. In regard to the dust catcher or air filter (included in the view, Fig. 10), its purpose is to filter the air between the ash receiver and the exhauster, so as to prevent dust getting into the exhauster. The suction pipe from the receiver is shown on the left in Fig. 10, while the pipes on the right are the main suction pipes rising from the ash tunnels to the receiver.

Steam Piping.—The steam pipes from the boilers to the turbines are arranged on the unit system, a group of four boilers supplying each main turbine. The boilers and turbines can, however, be opened out to a 14-in. common main in order to give greater flexibility of working. The steam is taken from each boiler by a 7-in. pipe, and these pipes lead into a 10-in. main. Condensed steam is removed by separators. A 5-in. auxiliary pipe running the length of the

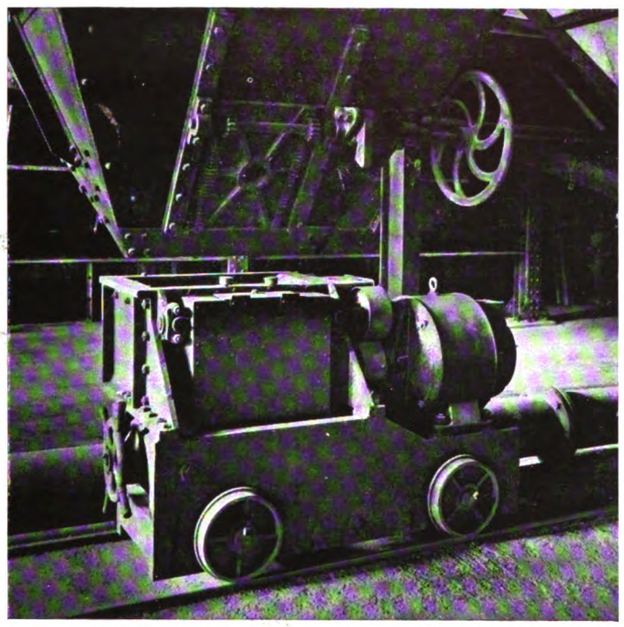

Fig. 9.—Clinker Breaker under Ash Chute Door.

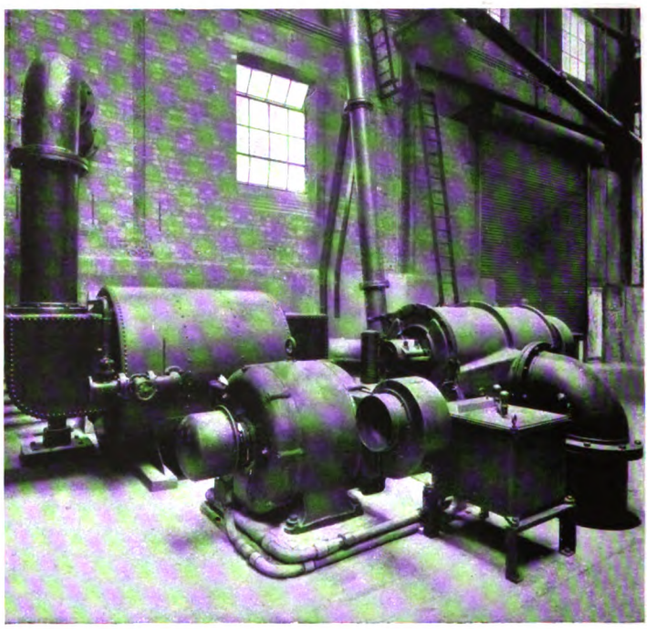

Fig. 10.—Exhauster Motor and Dust Catcher of Suction Ash Plant.

boiler house gets steam from the separators, and this supply is used for the auxiliary plant.

The Turbine House.

The turbine house (Fig. 13) is 257 ft. long by 55 ft. wide, and is to contain five main and three auxiliary generating sets. Three of the main sets are in position. Space is provided for a sixth main set when required. The main sets are turbo-alternators, made by Dick, Kerr and Company, Limited ; they are each of 5,000 KW. capacity, run at 1,500 revolutions per minute, and generate electricity at a pressure of 11,000 volts, three-phase alternating current at 25 cycles per second. The three auxiliary sets are composed of turbines of Parsons' make, driving through speed reduction gearing Dick-Kerr direct current generators. The turbines run at 5,000 revolutions per minute, and the generators at 575. The output of each unit is 400 KW. at 220 volts. General views and drawings are given in Figs. 11 to 19.

The Main Turbines.—These machines are of the high-pressure impulse type, and run at 1,500 revolutions per minute, with a pressure of 200 lb. per square inch, the steam being 200 deg. Fahr. superheated. Each turbine has one velocity disc with two rows of blades and a suitable number of low pressure discs, each with a single row of blades. The high pressure steam is confined to the throttle valve casing, the steam inlet casting, and the nozzles, and in consequence all trouble due to high temperatures in the turbine cylinder is avoided. The cylinder is made of close-grained cast iron split on the horizontal centre line. The barrel of the cylinder is bored in steps into which the stationary diaphragms are fitted. The high pressure end of the barrel is flanged and bored to receive the cylinder end cover. The low pressure end is designed to provide a path for the steam from the last row of blades to the exhaust orifice, which is at the bottom of the cylinder casing. The part of the exhaust through which the shaft passes is bored out to receive a labyrinth gland. Owing to the low temperature inside the cylinder with this type of machine, the air space between the cylinder barrel and the exterior steel cleading is a sufficient non-conductor, and further lagging material is unnecessary. The complete cylinder is tested hydraulically to about double the pressure of the steam entering the cylinder at full load.

The steam inlet casting, which is bolted to the cylinder cover, is provided with a machined facing, to which the nozzle segment is fitted. This casting is the connection between the throttle valve casing outside the cylinder and the nozzle segment inside the cylinder. Ports in this casting provide passages for the steam from the nozzle valves to the proper part of the nozzle segment. The latter consists of a number of nozzles cast in Ruebel bronze. The steam expands in the nozzles from the stop valve pressure down to a pressure of from 10 to 40 lb. gauge, and it attains a high velocity with this drop in pressure. The reversing segment is made of mild steel, and bolted to the cylinder between the two rows of velocity blades. A dovetail slot is turned in it to receive the reversing blades. These are of profile section, stamped out of strip, a dovetail root being formed at one end and a tongue at the other. The blades slide into the groove in the reversing segment, distance pieces of bronze with dovetail root being placed between each blade. The blades are hammered up tight, and stop pieces

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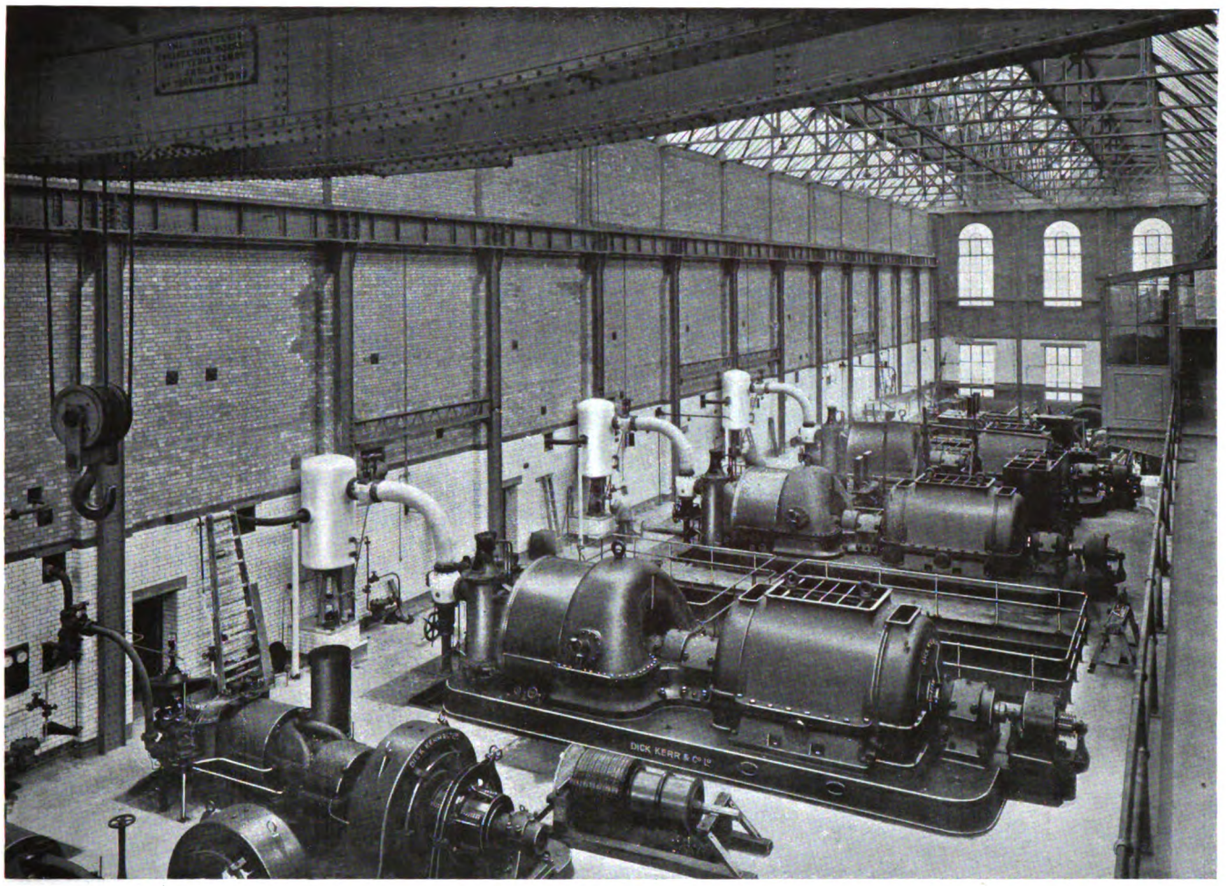

Fig. 11.—View of Turbine Room from Control Board Gallery.

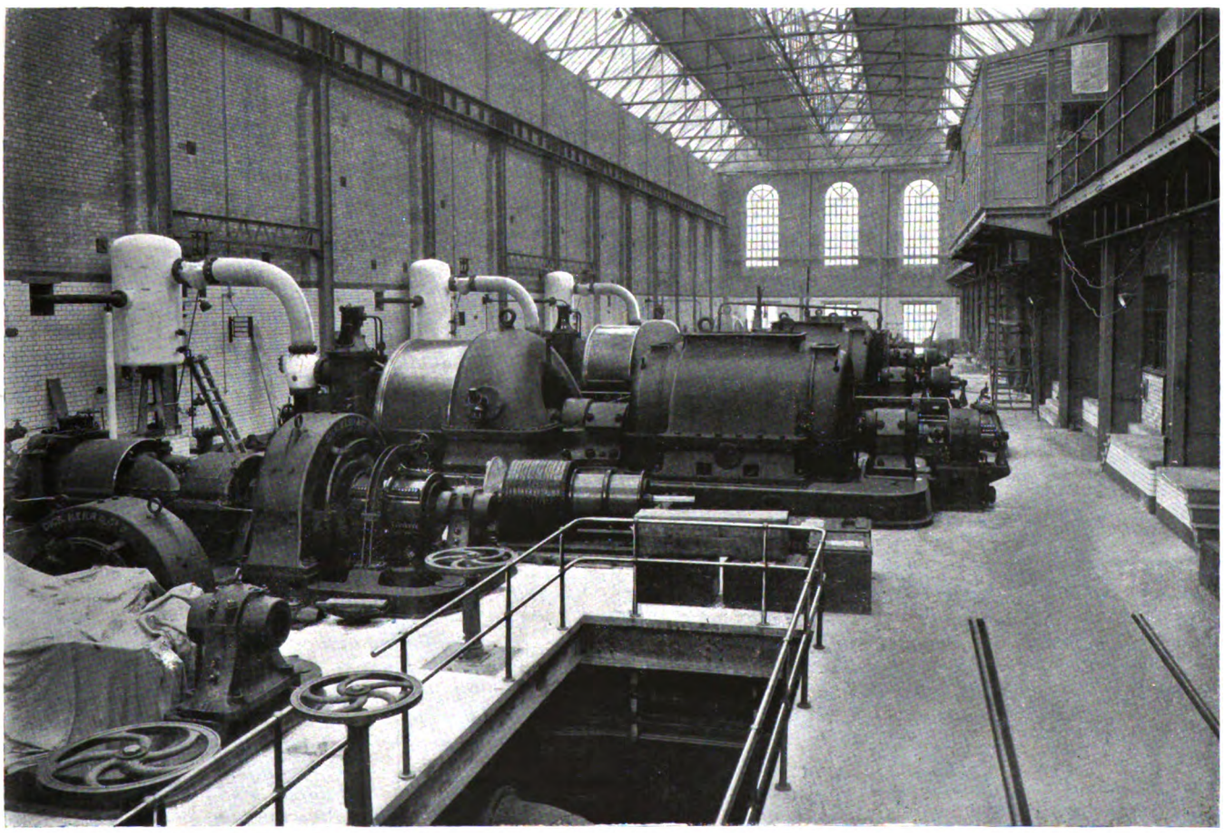

Fig. 12.—The Turbine Room—View from the Main Floor, showing Control Gallery on the right.

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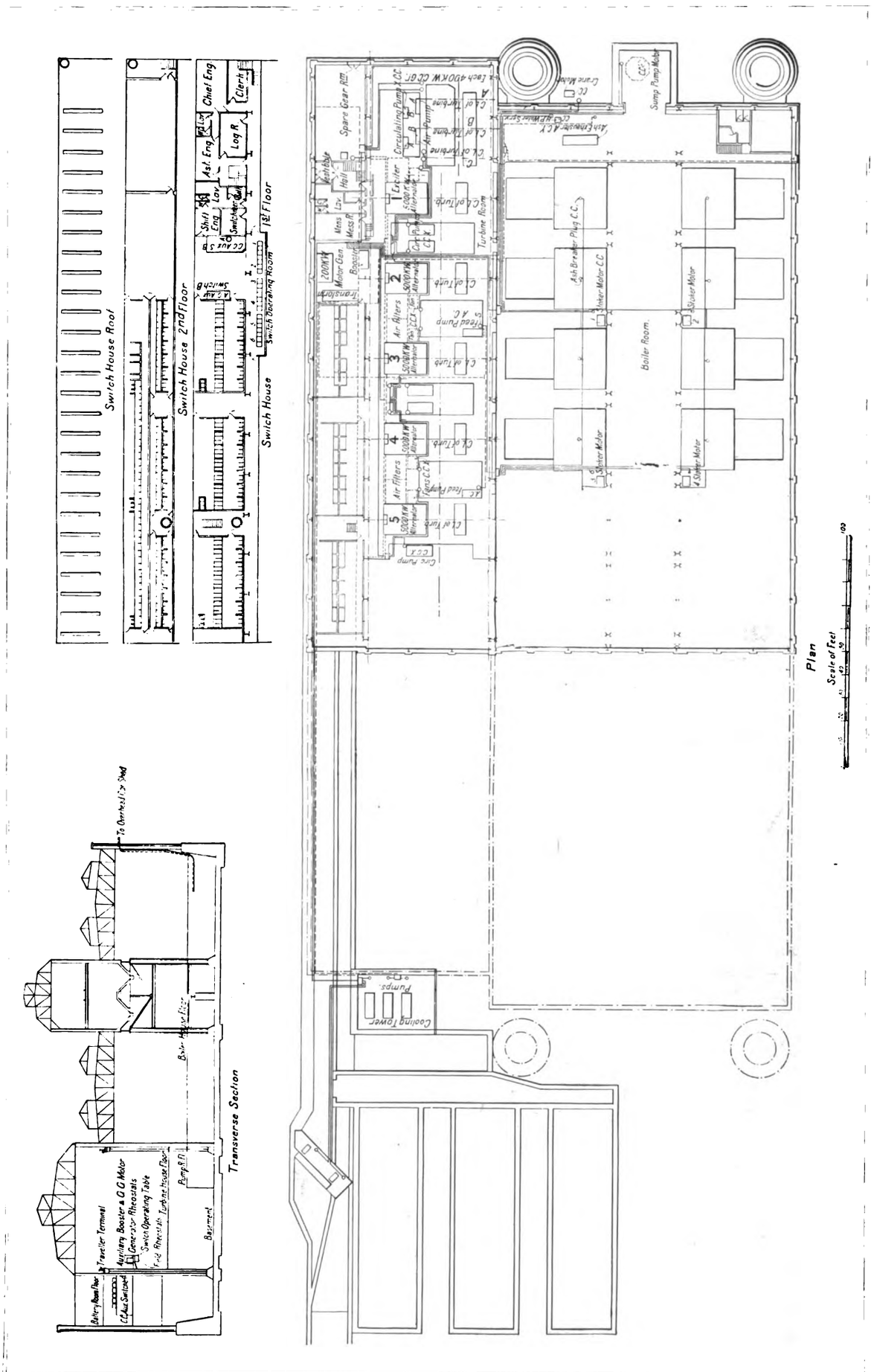

Fig. 13.—General Plan of Wimbledon Power Station and Cooling Towers—London and South Western Railway.

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are fitted at either end of the segment. A shrouding strip in sections is fitted along the tops of the blades. The low pressure diaphragms are cast in halves; the guide blades, which are of nickel steel, are tinned at each end and cast into the diaphragms near the periphery. The passage between the blades forms a channel in which the steam from the blades of the previous running disc is expanded and directed on to the blades of the next. The diaphragm glands are bored out, and grooves are turned in them to receive brass strips, which are turned to a sharp edge and bored to leave a fine clearance over the shaft. The latter is of pressed steel, oil toughened and annealed, with a strength of 75,000 to 85,000 lb. per square inch.

The velocity disc is of Siemens-Martin steel, having an ultimate strength of 70,000 to 80,000 lb. per square inch. Two dovetail grooves are turned on the rim to take the blading, which is similar to the reversing segment blading. A port is cut in each dovetail slot through which the teeth are dropped. When all the blades are in place the ports are closed with copper caulking pieces. The tips of the blades are shrouded in sections to allow for expansion. The low pressure discs are also of Siemens-Martin steel, with the same ultimate tensile strength as the velocity disc. The

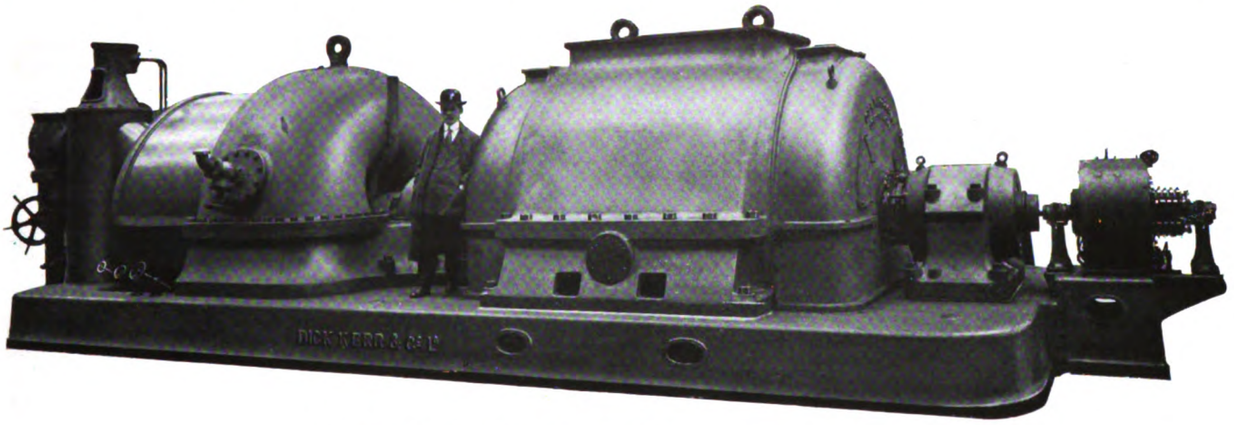

Fig. 14.—One of the 5,000 kw. Dick-Kerr Turbo-Alternators.

blades are formed of brass strip. The blade and distance piece straddle the disc rim, a portion of the blade fitting into a radial slot cut in the edge of the disc. Two holes are drilled through the blade and distance piece to correspond with the holes in the disc, and the blade and distance piece are secured by iron rivets passing through the holes. The usual shrouding in sections is provided for the blades.

A centrifugal governor operates the valve spindle by means of an oil relay, so that the governor has only to operate a relay valve, which admits oil under pressure to either side of the piston in the relay cylinder. This piston is directly connected to the valve spindle. Hand adjustment is provided to vary the speed of the turbine while running, by plus or minus of 5 per cent. The governor is driven off the turbine shaft by a mild steel worm and a bronze worm-wheel.

In regard to the nozzle valves, any one of three methods of operation is employed on Dick-Kerr turbines, according to the circumstances. The three methods are (1) hand operated and in series with an automatically operated throttle valve; (2) automatically operated and in series with an automatically operated throttle valve; (3) automatically operated without a main throttle valve. The turbines in the Wimbledon station are worked on the third system. The valves admit steam to the various ports in the steam inlet casting, and enable various sections of the nozzle segment to be shut off in order to obtain maximum economy at various loads. The first of the three methods referred to is used on a turbine on which the load is not a very variable one, while the second and third methods are used where the load is very variable. The valves are of the mushroom type of drop-forged wrought-iron with circular nickel steel seatings. When the second method of operation is used the steam supply to the open nozzles is controlled by the main throttle valve. The automatic nozzle valves consist of four or more double-beat valves, mounted vertically one over the other on an extension of the main throttle valve spindle. This spindle slides through the valves and at the proper time lifts them by means of steel stops. As the main throttle valve lifts, it admits steam first of all to the section of the nozzle segments, which is always open. Further travel of the spindle lifts the lower nozzle valve, admitting steam to another segment, until, if the turbine is on overload, all the valves are lifted and all nozzle segments are passing steam. The actual arrangement in these Wimbledon turbines is as just described, except that as they come under the third method of operation, an extra nozzle valve is fitted controlling that portion of the segment which in the second method is always open, and with the fitting of this extra valve a main throttle valve is unnecessary. As the spindle operated by the governor rises, the bottom valve is lifted, and steam admitted to the first nozzle segment. Further travel of the spindle operates the other valves in a similar manner to that in type 2.

The machine is fitted with a safety and emergency governor quite distinct from the main governor. It shuts down the stop valve when the turbine speed exceeds normal by 10 to 15 per cent. This governor consists of a cylindrical weight of tool steel moving in a hole drilled radially through the turbine shaft. The weight tends to move outwards by centrifugal force, and it is kept in place by a spring in compression. Immediately the speed attains a value that enables centrifugal force to overcome the spring, the weight moves out, strikes a case-hardened steel lever, releases a knife-edged poised lever, and permits a powerful spring to close the stop valve. The latter is fitted with an internal pilot valve, and both are closed by the same valve spindle. The pilot valve is used for warming up and for starting the turbine.

Labyrinth glands are fitted at the high pressure end to prevent steam escaping, and at the low pressure end to prevent air being drawn in. The high pressure gland has only to seal against a pressure compared with the atmosphere of from 10 to 40 lb. per square inch, while the low pressure gland has to seal against the

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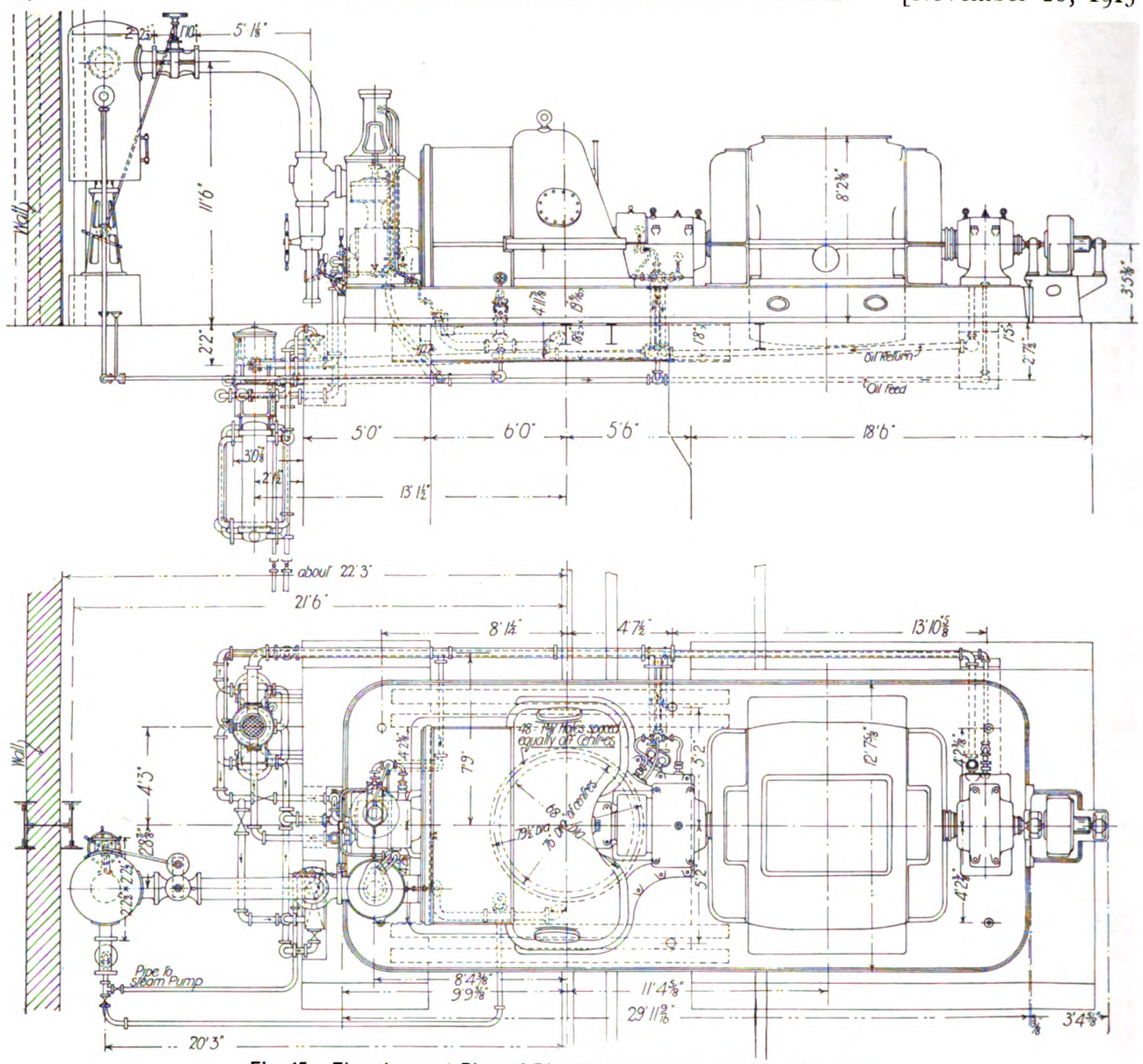

Fig. 15.—Elevation and Plan of Dick-Kerr 5,000 kw. Turbo-Alternator.

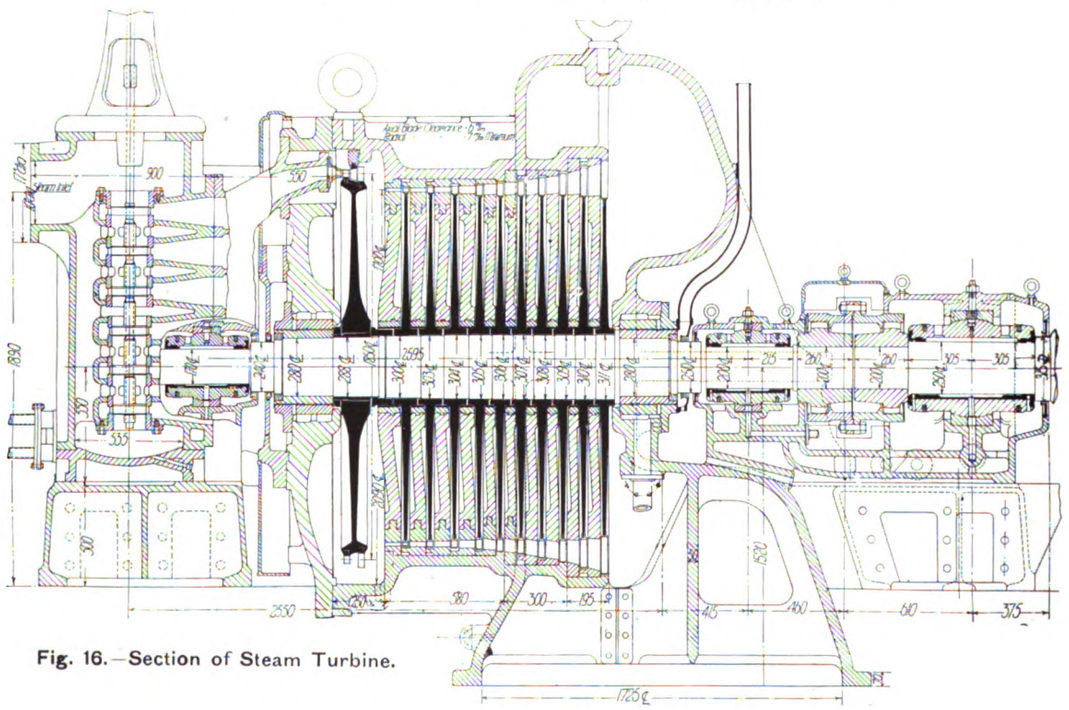

Fig. 16.—Section of Steam Turbine.

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difference between atmosphere and the vacuum of the condenser of about 13 lb. per square inch.

Hot oil from the bearings of the turbine flows by gravity into a settling tank, from which it overflows through fine gauze strainers into a reservoir. From

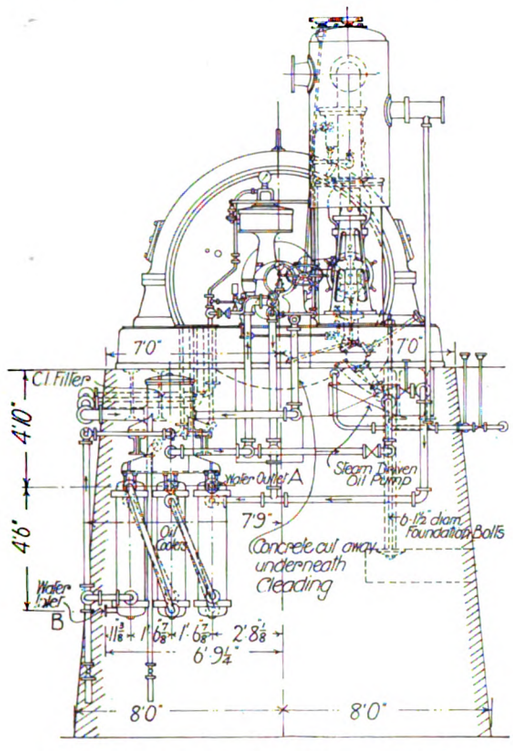

Fig. 17.—End Elevation of Steam Turbine.

this the hot, clean oil is pumped and forced through an oil cooler back to the turbine bearings. A duplex steam-driven oil pump is provided in parallel with a gear pump. The former is used for flushing the bearings before starting up. The bearing shells are of cast iron lined with white metal, and each bearing is provided with a thermometer pocket, so that its temperature can be ascertained. A thrust bearing is provided at the end of the turbine shaft to keep the rotor in its correct position relative to the stator. There is no end thrust from a turbine of this type.

The Alternators.—The alternators, which are connected to the turbines by flexible couplings, are two-pole machines, rated at 5,555 KVA. They yield three-phase current at a pressure of from 11,000 to 11,500 volts. Each has its own exciter mounted on the end of the shaft, and the machine is of the totally-enclosed chimney ventilated type. The frame consists of two shells with a space between them, the outer portion being provided at the top with a chimney opening, through which the heated air is expelled. Cool air is drawn in at the bottom of each end shield through air filters supplied by the Premier Cooling and Engineering Company, circulated through the rotor and through the air ducts in the stator laminations into the hollow stator, and expelled through the opening at the top. The stator laminations are of thin steel and the slots for the winding are punched on one side and dovetail slots on the other. The slots in the laminations are of the nearly-closed type, forming tunnels through which the coils are threaded. The coils consist of copper bars. Their insulation is of pure mica with an outside wrapping of leatheroid for mechanical protection. The coils are vacuum dried, and after insulation are formed under hydraulic pressure. The stator end windings are formed of strip copper insulated with pure mica, cambric tape, and empire cloth. They are former wound, so that in case of replacement no forming work is needed, the joints only having to be made. Particular attention has been paid to the ample proportions of the stator end winding supports, which consist of massive brackets of bronze. These brackets enable the alternator to withstand excessive overload without displacement of the end windings.

The connections from the stator windings are made of flexible vulcanised rubber-insulated, taped and braided cable. These connections are led through porcelain insulators, supported from the lower portion of the frame, and terminate in brass sockets to which the connections to the switchboard are joined.

The rotor is of the cylindrical type, the shaft and rotor itself being formed out of one solid steel forging. Longitudinal slots of the open type are machined in the body to receive the field windings, which are held in place by wedges of manganese bronze. Longitudinal holes are bored right through the rotor body, and air is blown through these and discharged through slots which are turned at regular intervals round the body, and correspond with the ventilating ducts in the stator

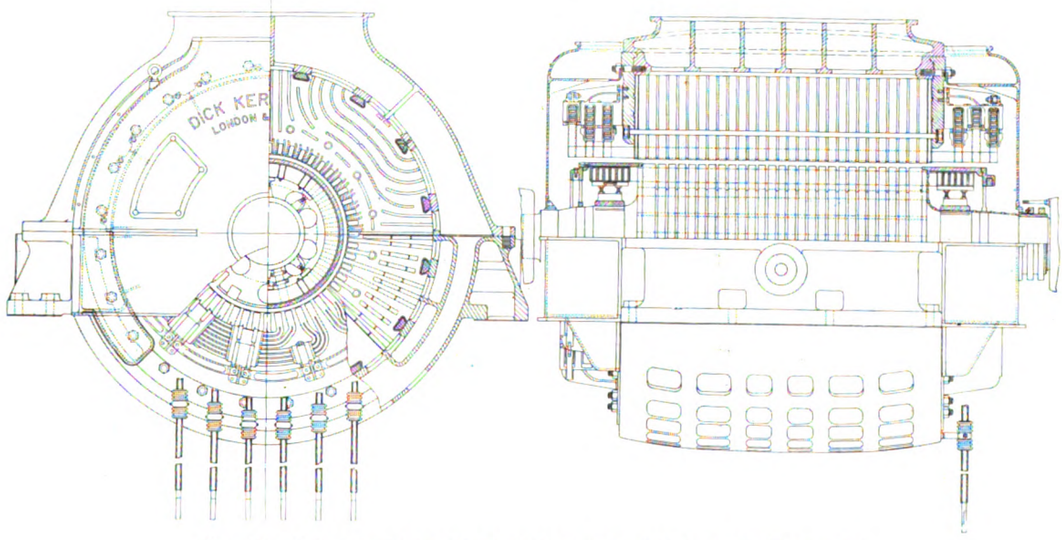

Fig. 18.—Cross and Longitudinal Sections of Dick-Kerr Alternator.

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laminations. Special manganese bronze end bells cover and support the rotor end windings. The rotor coils are former wound of strip copper insulated with mica. They are secured in place in the slots in the rotor body by wedges of manganese bronze. The rotor end connections are insulated with mica, cambric tape, and empire cloth, and are held together by bands of strip metal, clamped by tightening screws. The collector rings are of special steel, shrunk hot over a steel sleeve, and insulated from it by micanite rings. The leads from the field coils to the rings are protected by metallic caps fitted over the shaft and to the end of the rotor body. The brushes are of graphite, and are mounted in a gear consisting of two brass partially segmental boxes, divided into compartments. Leads from the brush gear to the source of excitation are protected by a cap. The exciter is a small continuous current machine, driven from the alternator shaft by a flexible coupling.

The makers guarantee that with alternators of this class, after a continuous run at normal full load, no part of the machine will have a temperature rise exceeding 40 deg. Cent. above the surrounding atmosphere. The machine will withstand an overload of 25 per cent. for two hours and 50 per cent. for five minutes without excessive heating.

The Auxiliary Turbo-Generators.—These are used for supplying current to motors, and for lighting at the power station and car repair shops. They are also used to provide part of the current for lighting the railway stations and for the automatic signalling on the railway. For this purpose the 220-volt direct current is led from the auxiliary switchboard to two small Bruce Peebles motor-generators (Fig. 20) which convert it into single-phase current at 3,300 volts, 75 cycles per second. This supply is controlled in its outgoing by a small switchboard, whence it is carried by cable feeders to various places on the railway where automatic signalling is used. Before being sent into the track rails it is reduced in pressure by transformers.

An interesting feature about the auxiliary sets is the speed reduction gearing between the turbine shaft and the generator shaft. It is a single-reduction double helical gearing, enclosed in a cast-iron casing. The teeth of the gear are cut by a specially designed plant, which ensures great accuracy, and thus noise and undue wear are prevented. Spray lubrication is employed.

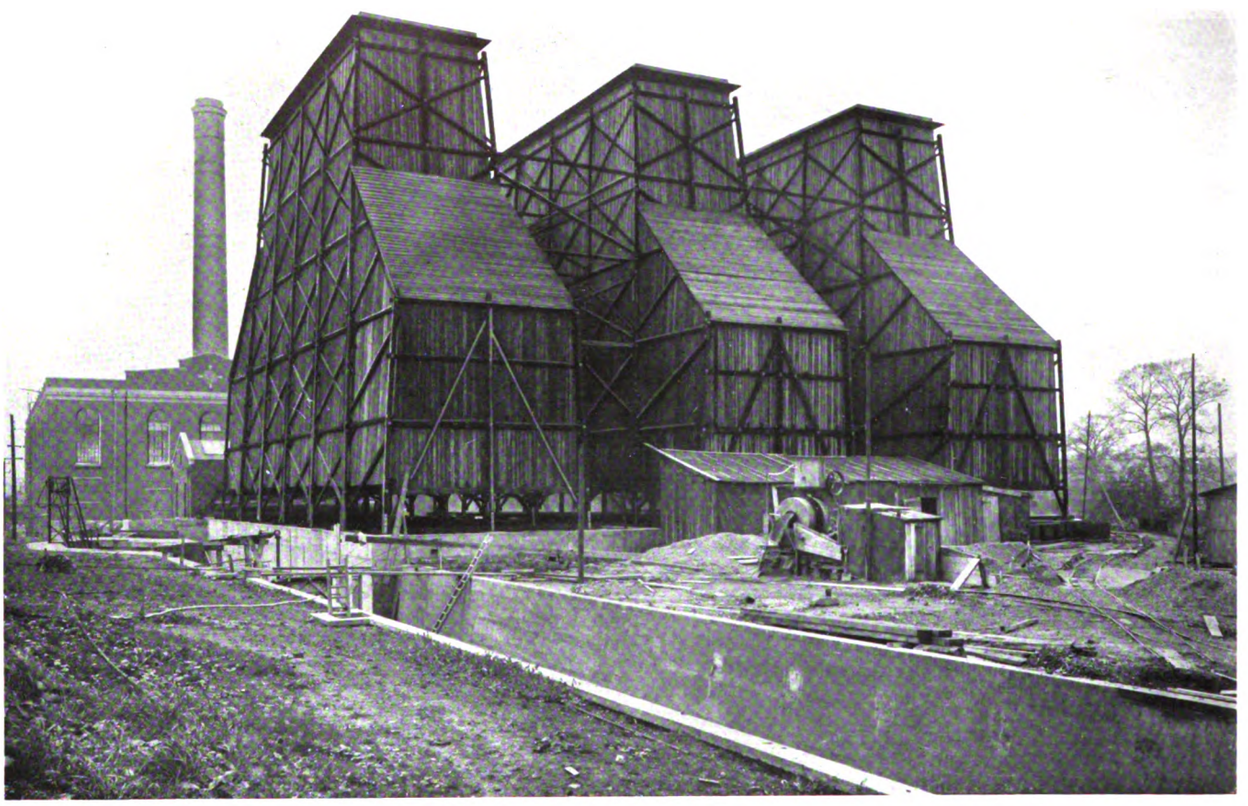

Fig. 19.—The Cooling Towers and Canal.

In connection with these auxiliary sets, a 220-volt Tudor battery is provided on the top floor of the switchgear galleries. It has 110 cells, and on a three-hour rating its capacity is 1,150 ampere-hours. Its purpose is to ensure the supply of current for control purposes.

Circulating Water.—Under normal conditions the supply of circulating water for the condensers is obtained from the River Wandle. For the purpose of conveying the water to and from the power station, two ferro-concrete ducts have been constructed. The intake duct has a fall towards the power station, so that the water flows in by gravitation. Two motor-driven screens are provided in the duct for removing leaves, weeds, and other refuse from the river water. The outer, or coarse screen, consists of fixed bars, cleaned by means of a motor-driven rake, and is capable

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of dealing with 2,000,000 gallons of water per hour. The inner, or fine screen, is a perforated disc which is kept in rotation by a motor. The top of the disc is kept clean by water jets directed on it from the back. Any refuse that may have collected in the perforations is thus driven into a catching trough, from which it is led into a skip. The latter is hoisted by a crane, and emptied into a wagon. The purified water is led to the condensers by a pipe and branches. The water after discharge from the condensers flows back to the

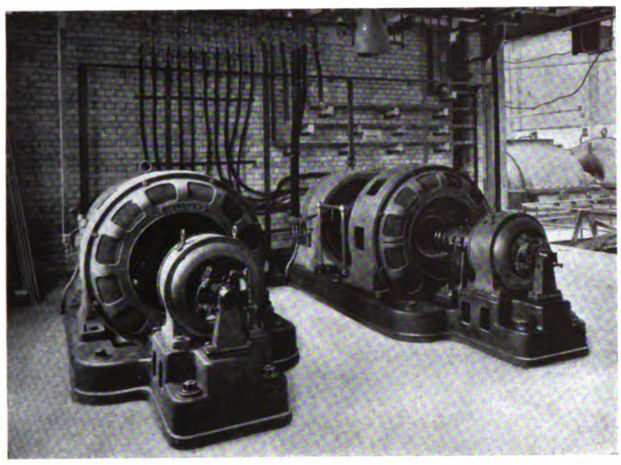

Fig. 20.—Bruce-Peebles Motor Generators for Signalling and Lighting.

river over a series of cascades, and by this means it is cooled to within a few degrees of the inlet temperature before it is finally discharged into the river.

Cooling Towers.—During periods of continual drought the supply of water from the river will be insufficient, and at such times a part or the whole of the circulating water will be drawn from the outlet duct by means of motor-driven centrifugal pumps, and pumped through cooling towers which have been erected beside the water ducts at the end of the power house nearest the river. The cooling towers (Fig. 19), supplied by the Klein Engineering Company are three in number, each 100 ft. long by 26 ft. wide (centres of extreme posts), with a total height of 70 ft. The framing is constructed entirely of pitch pine of large section, strongly braced in all directions, and creosoted under pressure. The coolers are placed parallel to each other, with a space of 14 ft. between each, and are braced together. Each cooler has a separate water inlet pipe regulated by a large sluice valve, and each is provided with a separate main trough. From this trough the three secondary troughs are served, and the supply to each can be regulated. The water distribution is of the Klein latest and improved type, and has been specially designed to atomise the water thoroughly in its passage through the cooler. The stack is of extremely strong construction, so that the risk of breakdown or renewals has been reduced to a minimum. At the same time a free passage for the air is given to all parts of the cooling medium. All the stack has been dipped in sideroleum to preserve the life of it. All the ironwork used throughout, including bolts, etc., is heavily galvanised. A gallery is carried along the ends of the three coolers, access to which is given at each end by a strong wood ladder fitted with a double handrail. The gallery is supported on steel stanchions and connecting girders, and it has a double floor, the lower one supporting the cast-iron supply pipes, which vary in diameter from 30 in. to 16 in.

Condensing Plant.—Five large surface condensing plants have been supplied by Willans and Robinson, Limited. They are fitted with the Willans-Muller system of air extraction. Each plant is designed to deal with the steam exhausted from one 5,000 KW. turbo-generating set, and to maintain a vacuum of 28½ in. (bar. 30 in.) when supplied with cooling water at a temperature of 65 deg. Fahr. There are also two smaller and similar plants installed by the same firm, each capable of dealing with the steam exhausted from one 400 KW. auxiliary turbo-generating set working under the same conditions as above.

In the Willans-Muller system of air extraction the air is removed from the condenser by means of a water jet ejector, water being supplied to the ejector by a centrifugal circulating pump of the ordinary type. No sealing tanks are required, and as the air is extracted at the temperature of the cooling water, the extraction takes place under conditions of maximum efficiency. In the case of the condensing plant for the 5,000 KW. turbines, the pump supplying water to the ejector and the condensed steam extraction pump are coupled together and driven by one of Willans and Robinson's single wheel impulse turbines. A view of this machine is given in Fig. 21.

The two hot-well tanks to which the condensed steam passes each measure 14 ft. by 12 ft. by 9 ft. Lea recorders are attached. One Rees-Roturbo electric feed pump and one J. P. Hall and Son's steam feed pump are provided for each hot well. Each pump can deliver to the boilers 13,000 gallons of water per hour.

Current for the motors used for driving auxiliaries is obtained from the 220-volt direct-current supply. The turbine house is spanned by a 40-ton overhead travelling electric crane made by the Chatteris Engineering Works Company.

The Switch-Gear.

All the high and low tension switch-gear is placed in a separate bay, 21 ft. 6 in. wide, which runs the whole

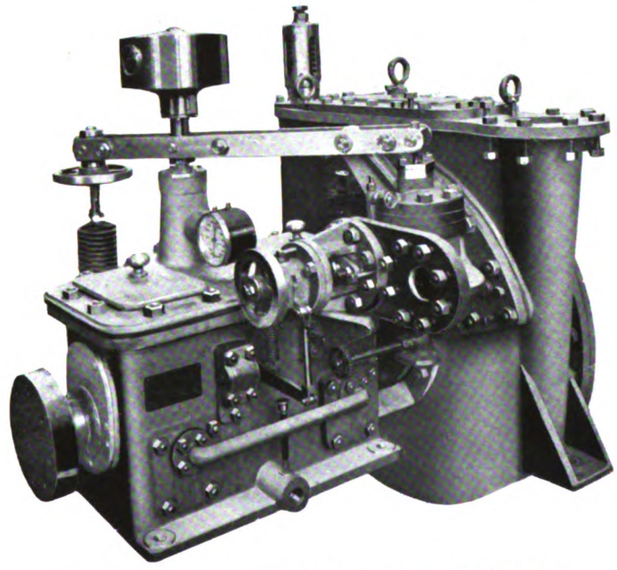

Fig. 21.—Willans and Robinson Impulse Turbine for Operating Condensing Pumps.

length of the turbine house. This bay also includes accommodation for the power-house staff, with offices and stores attached. For the high-tension part of the gear the remote control system is adopted; a view of the control board is given in Fig. 22. A brief description of the whole apparatus, which was manufactured and installed by the British Thomson-Houston Company, is as follows:—

The switch-gear is arranged in three groups, each group having two generators and four feeders connected

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to it. The switch-gear is distributed over three floors, being mounted in the centre of each floor so as to enable access to be obtained to both sides of the gear. The general distribution is :—Cable boxes and transformers on the turbine house floor, oil switches, operating mechanism and control room on the first floor, and the bus bars on the second or top floor.

The groups are separated by moulded stone walls fitted with steel doors, the doors of each equipment having different locks to prevent access being obtained to the wrong cell. The three groups are each connected through an oil switch to the main bus bars, which run the entire length of the switch-room. The connections between the various pieces of apparatus are all bare copper carried on porcelain insulators.

All the apparatus is contained in fireproof moulded stone cells, with barriers between the phases. The front of the cells is covered by expanded metal screens except in the case of the oil switches, where sheet steel is employed. The oil switches (Fig. 23) are of the well-known B.T.H. motor-operated type, having two breaks per phase, each break taking place under oil in a separate drawn-steel tank.

The generators are protected by the balanced current method, two main 3-core cables being run from the six generator terminals to the two cable boxes at each switchboard, from which point three of the conductors pass through the protective and instrument current transformers to the main generator oil switch, the remaining three passing through three protective transformers, being then coupled together by a copper bar to form the neutral point of the generator. This point is connected to earth through a limiting resistance by means of a single-pole solenoid-operated oil switch.

The control board (Fig. 22) is of the bench board type, and is mounted on the front of the gallery overlooking the engine room, from which it is screened off by glass. The control wiring between this board and the switch-gear apparatus is run in steel pipe. Duplicate synchronising gear is provided.

Protection against surges is secured by means of horn gaps and resistances, the horn gaps being connected through three single-pole hand-operated oil switches to the main bus bars. The protective and instrument current transformers are all of the porcelain insulated type.

In addition to the main switchboard there are two auxiliary boards, one for alternating and the other for continuous current. The auxiliary alternating-current board (Fig. 24) consists of four enamelled slate panels having the oil switches and bus bars mounted at the back, the whole of the back being enclosed by expanded metal screens. This board controls the supply from three 200 KVA. single-phase transformers, and three power circuits. The auxiliary continuous current board (Fig. 25) controls the three 400 KW. auxiliary turbo-generators, an 800 ampere battery and booster, two 100 KW. 75 cycle lighting sets, and ten power circuits, and consists of enamelled slate panels, having the instruments and apparatus on the front and the bare copper bus bars on the back.

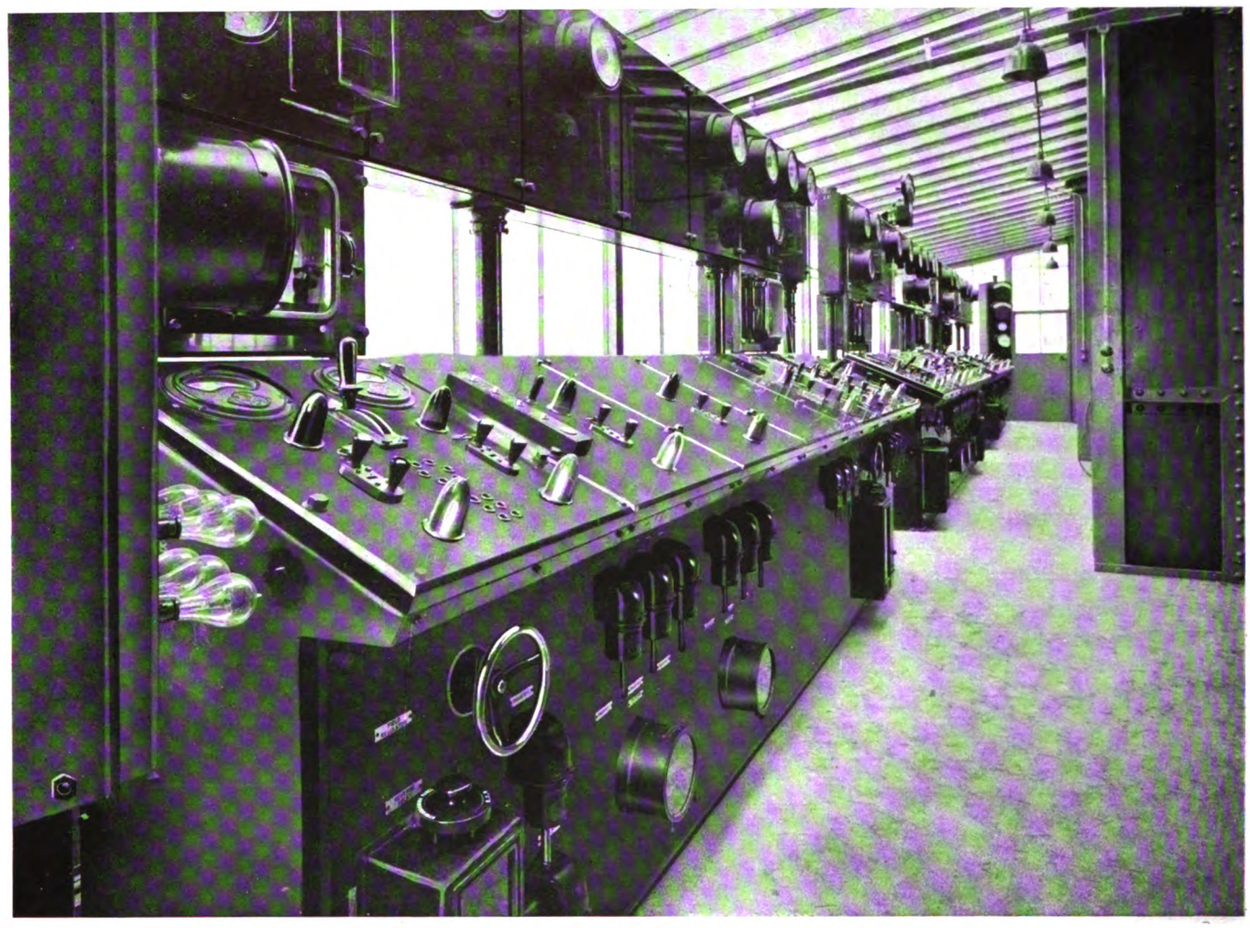

Fig. 22.—Control Bench Board in Gallery overlooking Turbine Room.

H.T. Cable Distribution.

Current at 11,000 volts is distributed from the power house by means of three-phase paper-insulated lead-cased and heavily wire-armoured cables, manufactured and laid by Messrs. Siemens Brothers and Company, Limited, Woolwich. The cables are generally run

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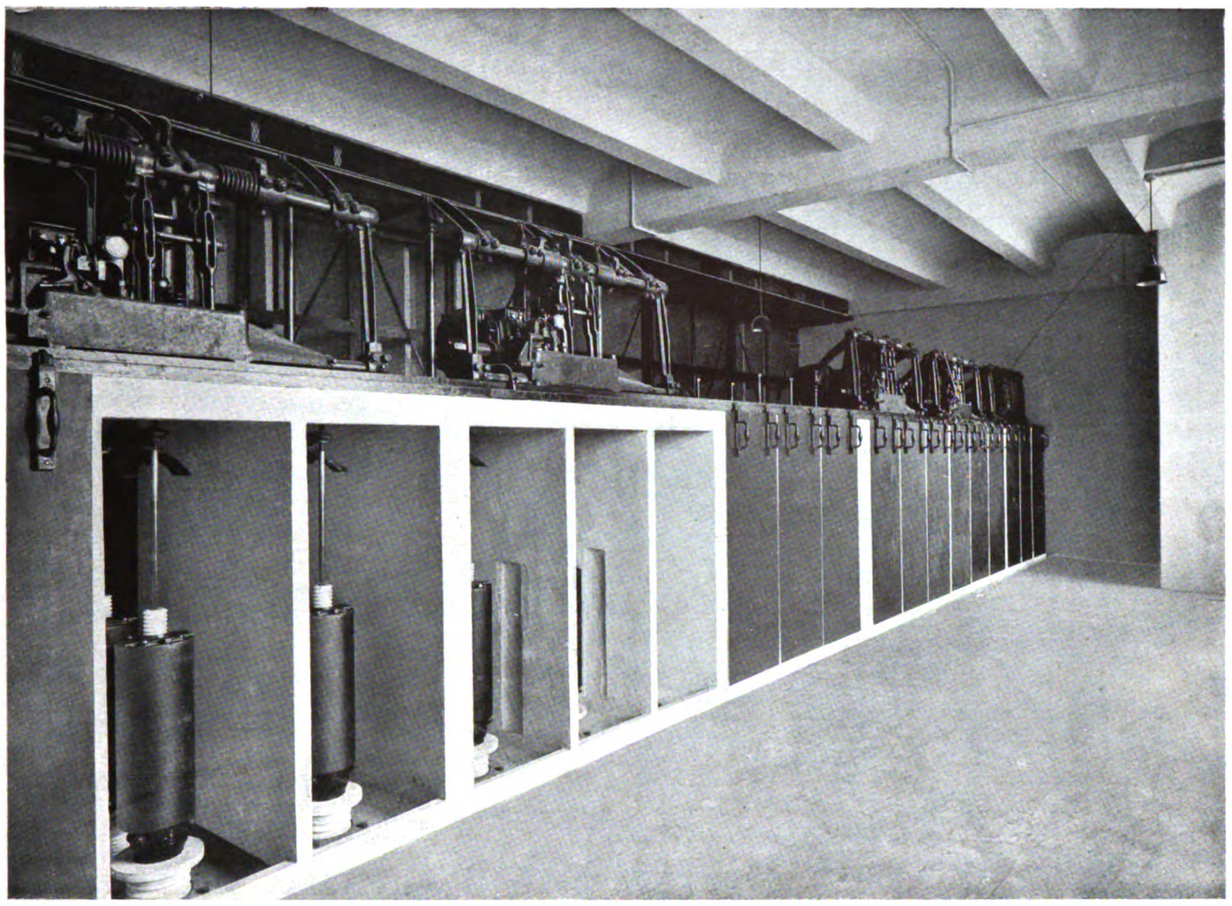

Fig. 23.—High Pressure Oil Switches.

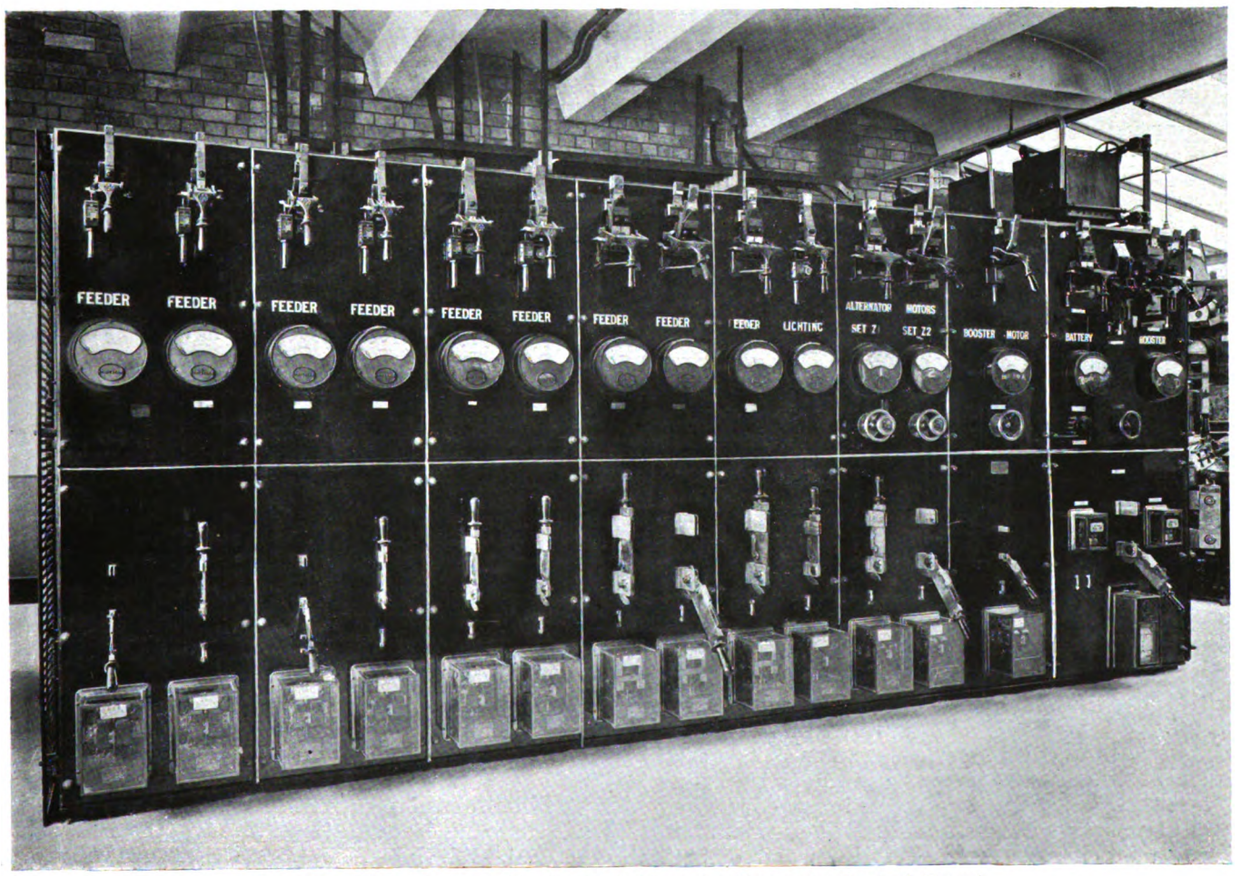

Fig. 25.—Direct-Current Feeder Switchboard adjacent to Control Board.

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above ground, being hung on cast-iron brackets bolted to creosoted wood posts, 5 ft. 6 in. apart. Where the cables cross the running lines, and at level crossings and station platforms they are laid underground in Howard asphalt troughing.

The fact that the feeders are supported on posts by the side of the track called for special provision to be

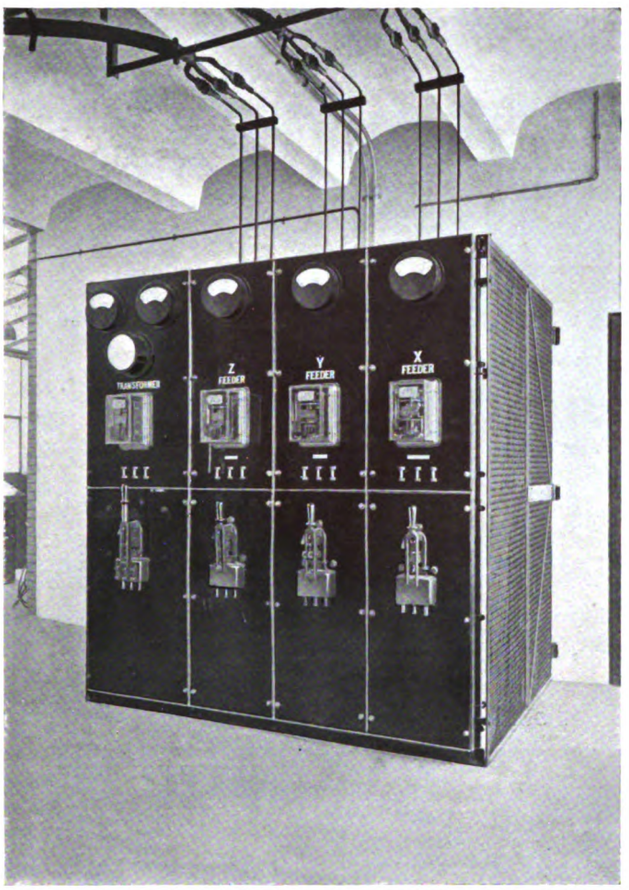

Fig. 24.—Auxiliary Alternating Current Board.

made to prevent any trouble due to expansion and contraction. Change of temperature might cause in this way considerable strain on the joints. The type of joint (Fig. 26) adopted to meet this was a modification of Siemens' standard practice for mining cables, which combines efficient bonding of the wires with

long bolts which connect the two ends of the joint. The bolts are tightened until all strain is taken off the joint. An additional bonding of the sheathing is effected by tinned brass plates, placed between the cast-iron clamps, and connected by a tinned copper strap.

The cables were tested at the firm's works with a pressure of 25,000 volts for half an hour, and on the site after laying and jointing with 20,000 volts for half an hour. Finally, each cable is required to be switched on and off ten times under any working condition, and without any charging devices. Altogether upwards of 80 miles of three-phase cables of various sections have been supplied by Messrs. Siemens Brothers.

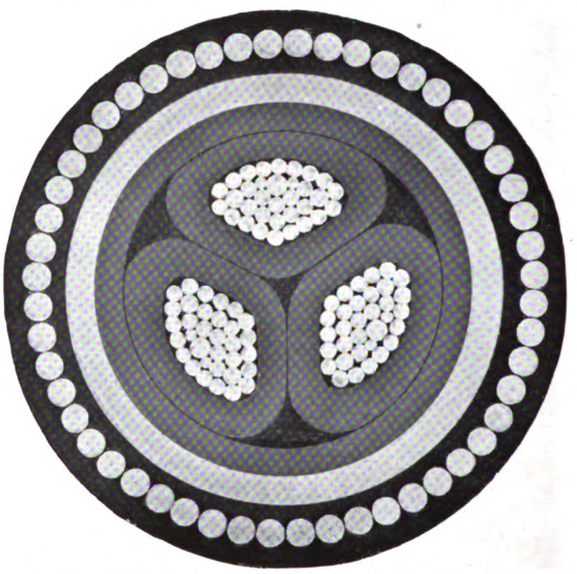

Fig. 27.—Section of High Tension Feeder Cable.

A typical cross section is shown in Fig. 27. It must be noted, however, that four sizes of cable are used, namely, ·2 sq. in., ·15 sq. in., ·1 sq. in., and ·06 sq. in.

A large proportion of the 11,000-volt feeder system is in the form of a ring main, and where duplicate cables are provided in this ring they are fitted with protective gear consisting of balanced relays which in the event of fault isolate the length of defective cable at both ends. Duplicate cables which do not form part of the ring main are provided with balanced relays at the feeding end and balanced reversed power relays at the receiving end. Two lengths of single feeder are fitted with Merz-Price protective gear, in connection with which three-core pilot cables have been provided.

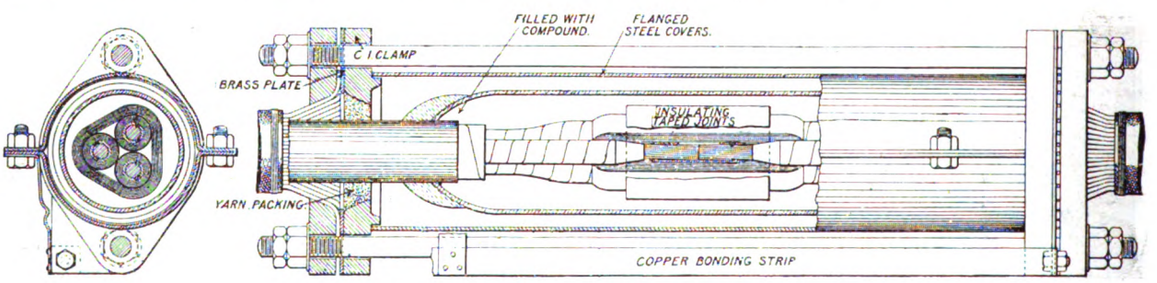

Fig. 26.—Sections of Joint of High Tension Cable.

mechanical strength, and protects the joint from strain. The three cores are connected by extra long copper sleeves, and the joint proper enclosed in a lead sleeve wiped on to the lead of the cable in the usual manner. This sleeve is protected by a pressed steel cover, made in two halves and bolted together. The armour wires are held at each end of the cover by a pair of heavy cast-iron clamps, which are bolted together by two

A diagram of the high-tension feeder cable connections to the sub-stations is given in Fig. 28.

Sub-Stations.

The high-tension current from Wimbledon is distributed to nine sub-stations through the cables just described. At the sub-stations it is transformed and converted to continuous current at 600 volts, at which

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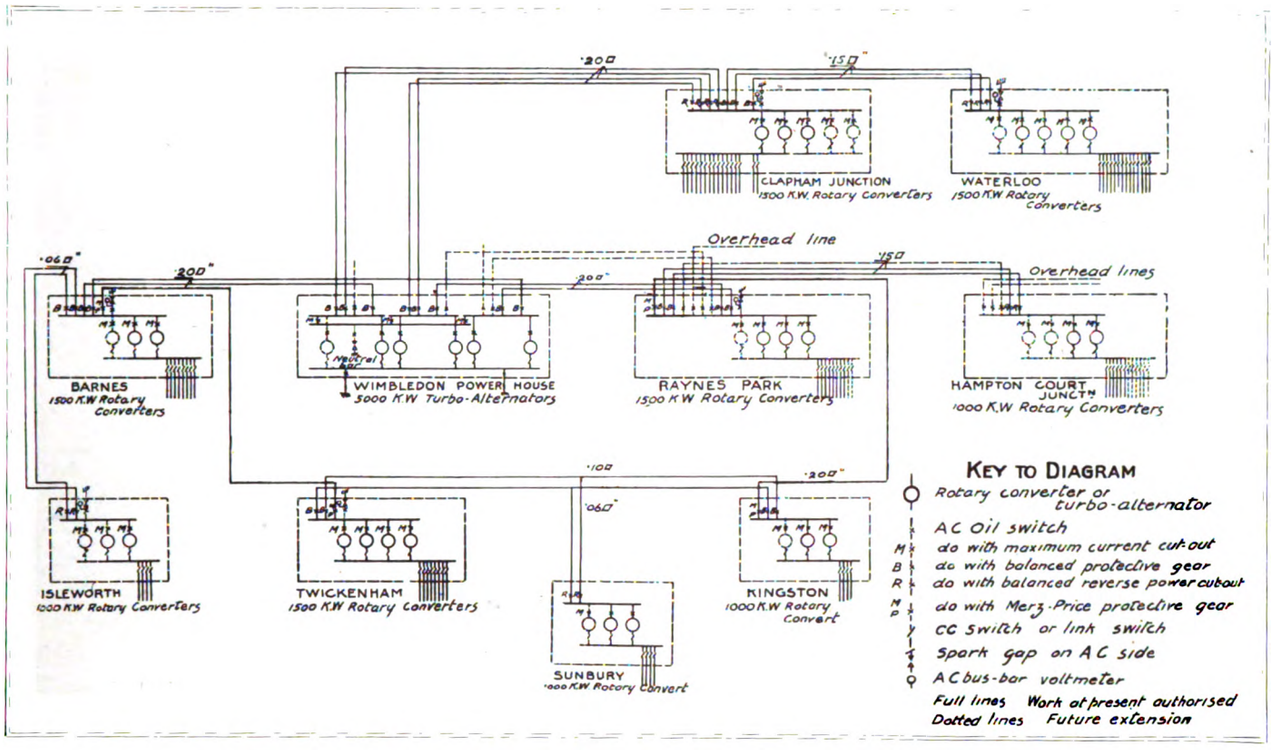

Fig. 28.—Diagram of High-Tension Feeder Connections from Power Station to Sub-stations.

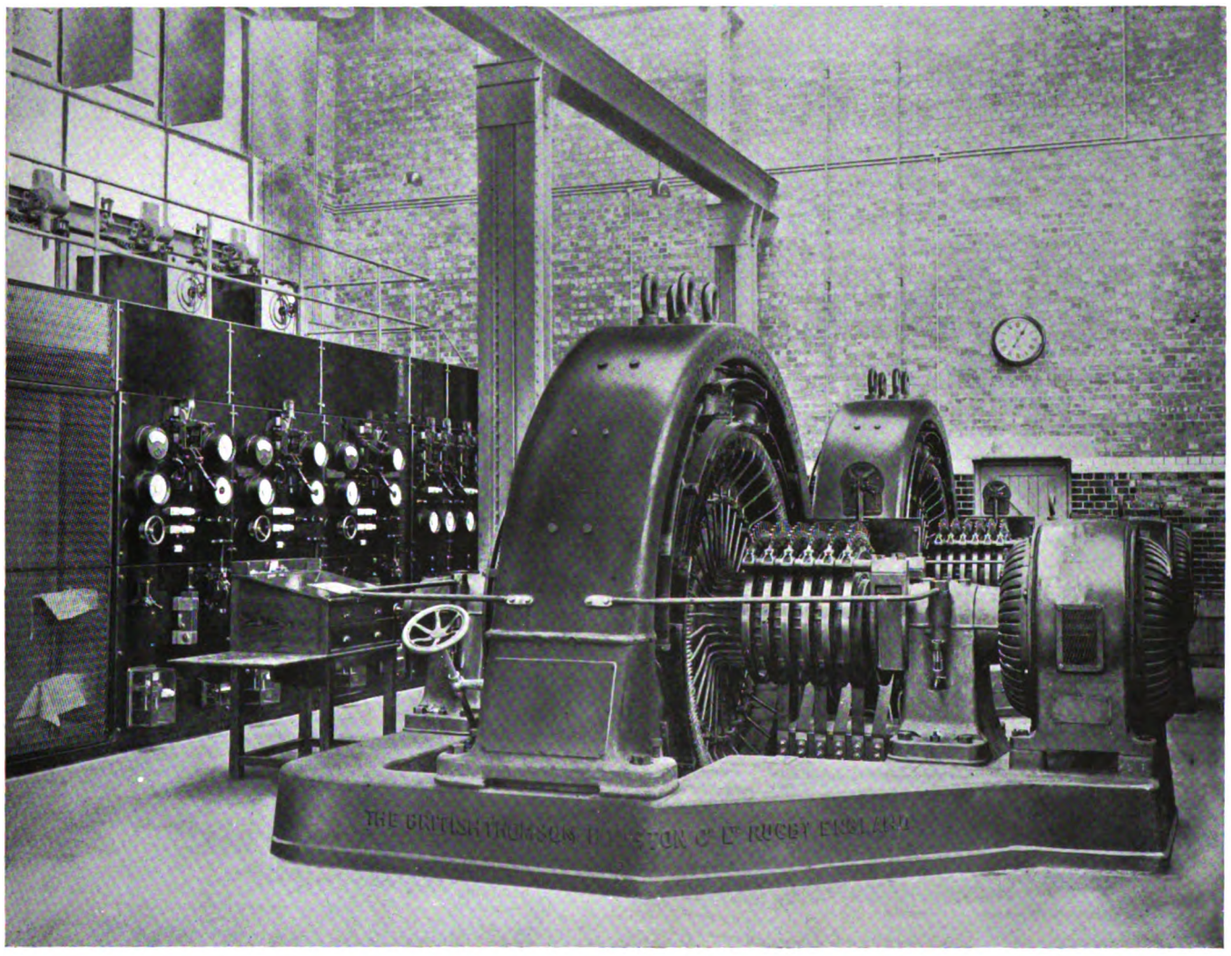

Fig. 29.—Two 1,500-k.w. B.T.H. Rotary Converters with Induction Motor for Starting. Distribution Board on Left. Raynes Park Sub-Station.

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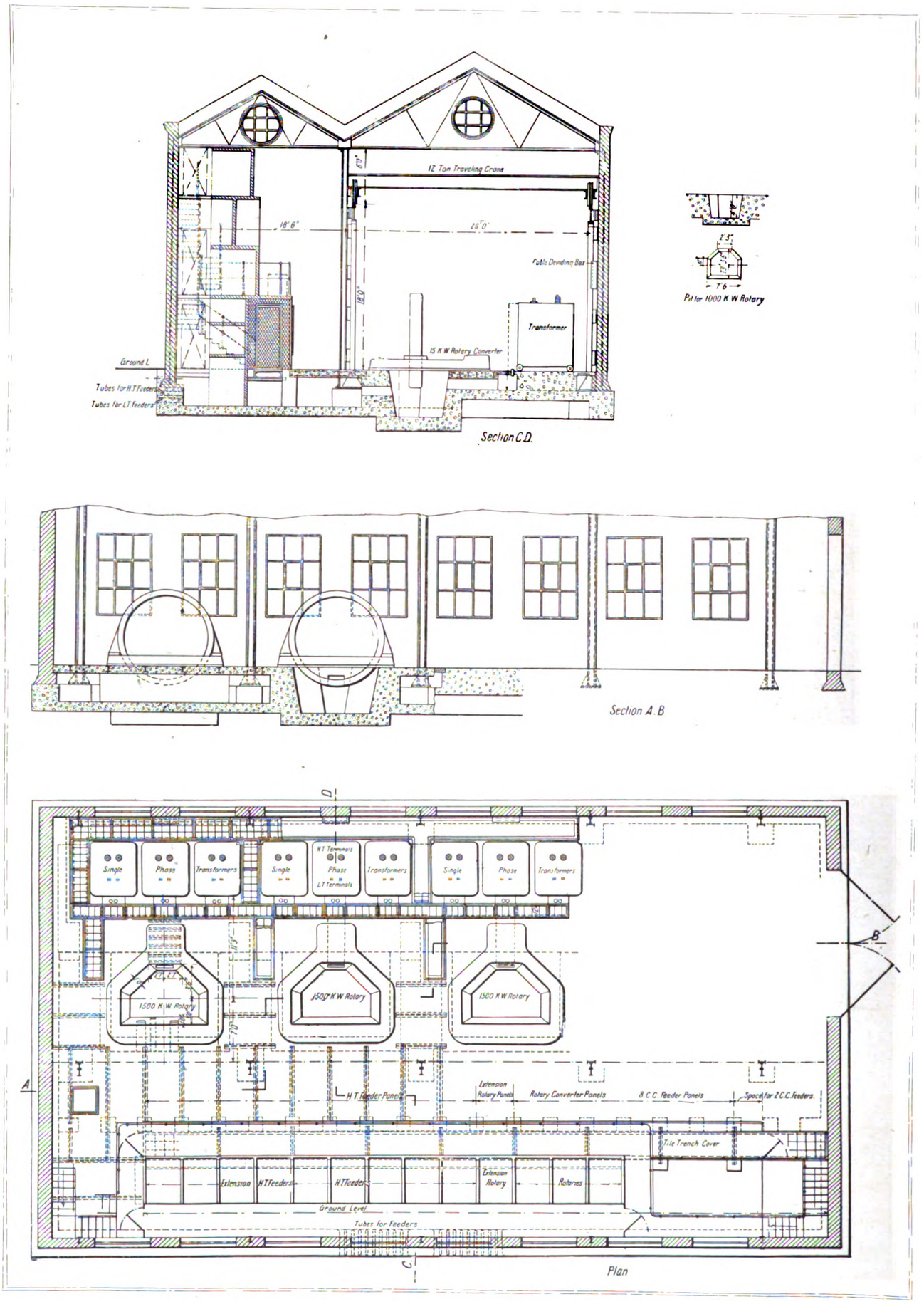

Fig. 30.—Plan and Sections showing Arrangement of Typical Sub-Station.

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pressure it is delivered to the conductor rails on the track. The sub-stations (Fig. 30) are situated at Waterloo, Clapham Junction, Raynes Park, Hampton Court Junction, Kingston, Sunbury, Twickenham, Isleworth, and Barnes. The buildings are similar in form except the one at Clapham Junction, which had to be erected on one of the passenger station platforms. They vary in length according to the number of machines to be accommodated, but have a uniform width of 46 ft. Each building is divided into two bays, one containing the rotary converters and the transformers, and the other the switch-gear. The equipment of the sub-stations, which was supplied by the British Thomson-Houston Company, consists of transformers, converters, high and low tension and (at some sub-stations) lighting and signalling switch-gear.

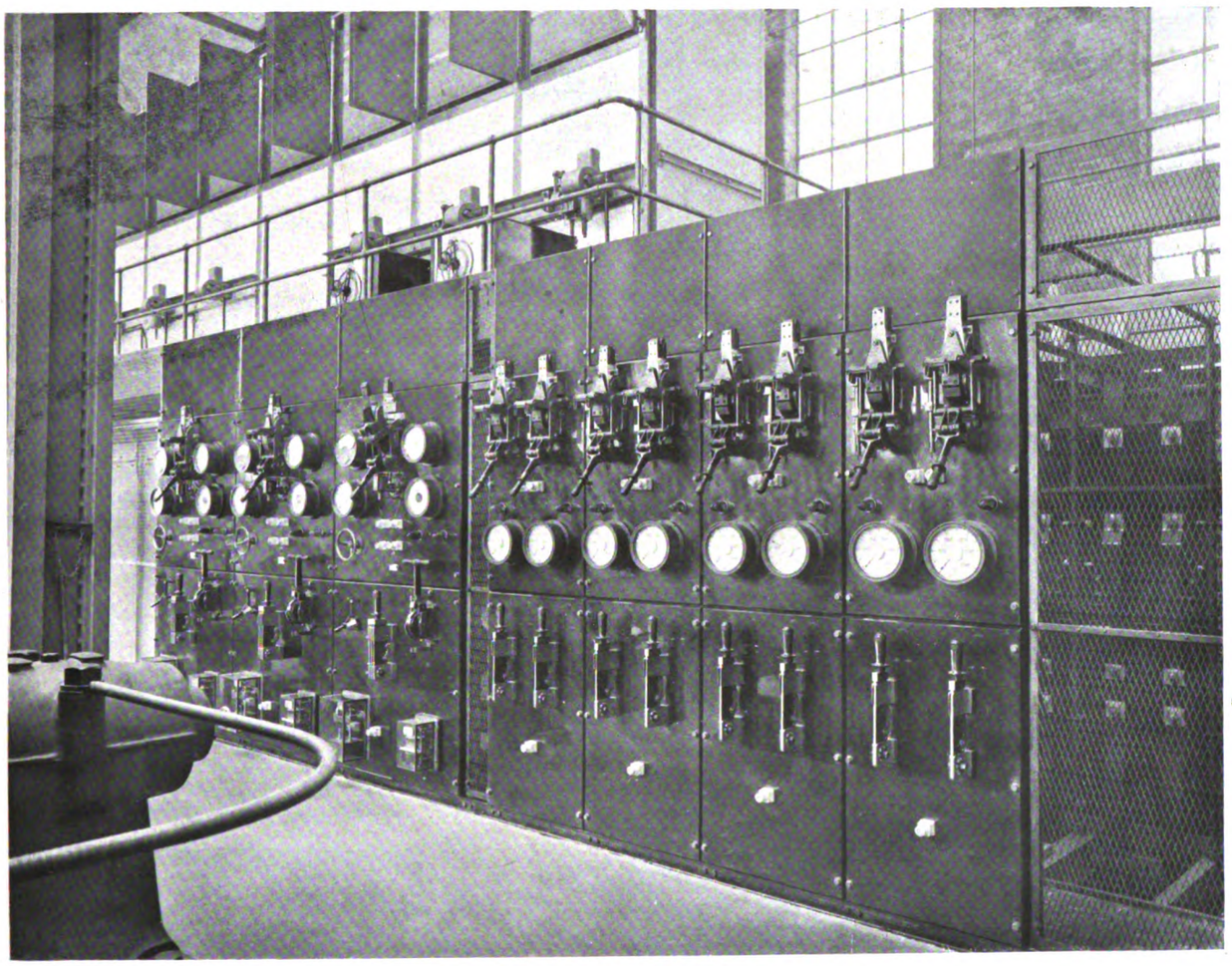

Fig. 31.—Distribution Board, Raynes Park Sub-Station.

The transformers, which are of the British Electric Transformer Company's make, are single-phase oil cooled units, three forming a machine unit. They are fitted with external radiating tubes. Each transformer is mounted on rollers, and arranged with lifting eyes. They are arranged to be connected in mesh on the primary side and diametrical on the secondary.

The rotary converters (Fig. 29) are of the reactance controlled six-phase type, arranged for self-synchronising starting with induction motor. There are fifteen 1,500 KW. machines, running at 300 revolutions per minute, and eight 1,000 KW. machines, running at 375 revolutions per minute, installed at present with provision for six more 1,500 KW. and five 1,000 KW. machines in the future. Great attention has been given to the question of clearances and creepage surface, and the rotary converters have been designed to prevent the accumulation of dirt on any of the surfaces of the machines. The distribution of these machines among the various sub-stations may be gathered from the high-tension feeder diagram (Fig. 28) already referred to.

The high-tension switch-gear is contained in moulded stone cubicles, the phases being kept in separate compartments by means of barriers, access to these cubicles being by means of steel doors. The locks on these doors are arranged in the same manner as on the main station switch-gear.

The switch-gear is arranged on three levels; the lowest (in the basement) contains the cable boxes, the middle the instrument transformers, and the upper level the oil switches and bus bars, a gallery giving access all round this upper level to the various apparatus. The passages round the extra high-tension switch-gear are all fitted with glass treads. All the connections are made by means of bare copper.

The current transformers operating the instruments and the tripping mechanism of the oil switches are all porcelain insulated. The oil switches, which are of the B.T.H. heavy tank type, are operated mechanically from the control panels by means of rods. Each phase is contained in a separate tank, and the mechanism is arranged so as to give a maximum clearance at the terminals of the oil switches. Locking-off gear is provided in the feeder isolating switches.

The whole of the low-tension connections, both alternating current and continuous current, are run

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in bare copper, supported on oiled slate insulators. The connections between the switch-gear and the transformers are made with 3-core paper-insulated and armoured cable.

The continuous current boards (Fig. 31) take the usual form of traction control panels, that is, slate panels having the instruments, circuit breakers, and switches mounted on the front with the bus bars and connections on the back. The sectional area of the bus bars in the various sub-stations ranges from 5 to 10 square inches. All the joints are faced, tinned and clamped together by means of heavy malleable iron clamps, thus avoiding the drilling of any holes in the bus bars, and all the bars and connections are painted with blue and red anti-sulphuric enamel. The panels controlling the rotary converters have the high-tension oil switch control handle mounted on the same panel as the continuous current circuit breaker and switch, also the high-tension instruments are arranged on one side of the panel and the continuous current on the other. The panels are enamelled on both sides, and all small wiring is carried out with bare copper wire secured to the panels by means of porcelain cleats.

Each of the continuous-current feeder panels controls two circuits, each of which has a maximum capacity of 5,000 amperes. The feeder circuit breakers are equipped with indicating lamps which, when the breakers are open, show the position of the breaker through which the different sections of conductor rail are fed from the next sub-station.

The lighting and signalling control boards are of the draw-out ironclad type, and control motor-generators (giving a single-phase supply at 75 cycles for lighting, etc.), and 15 KVA. transformers.

Lighting.—When referring to the auxiliary generators in the power station, it was mentioned that they were partly used for automatic signalling and for lighting. It can now be further explained that four motor-generators acting as frequency changers (supplied by Bruce Peebles and Company, Limited) are also installed in the sub-stations at Waterloo, Clapham Junction, Raynes Park, and Twickenham. These machines change the main 11,000-volt three-phase supply (first stepped-down by transformers) into 3,300-volt single-phase current, which is sent out by a cable along the line. This current is supplied to transformers placed in small brick chambers at intervals along the route, where for lighting purposes the current is transformed down to 220 volts. The 3,300-volt feeders are ·05 sq. in., twin core, paper insulated, copper taped, lead sheathed, and wire armoured, and are divided into sections at the transformer chambers where they are connected to oil switches. These oil switches are fitted with trip coils operated by relays, having operating coils connected to the copper tapes on the cables. In the event of a fault developing on a length of cable, the relays at each end of the defective length come into operation and trip the oil switches, thus cutting out the length.

There are in all seven motor-generator sets for lighting and signalling purposes—the four just referred to in sub-stations, the two previously mentioned in the power station, and the remaining one is at Waterloo. It acts as a stand-by to the other machines, and is independently driven from a 600-volt battery.

Low-Tension Feeders.—The low-tension feeders which leave each sub-station for the conductor rails are indicated in the diagram (Fig. 28). Chas. Macintosh and Company, Limited, were the contractors for supplying and laying the whole of these cables. The paper cables in connection with the scheme were manufactured at the Liverpool works of the Macintosh Cable Company, and the V.I.R. and bitumen sheathed cables at the Derby works. The laying of joints, feeders, jumpers, and negative cross bonds was carried out by the firm's contract department. The positive cables are of two sizes, viz., 1 sq. in., and 0·5 sq. in. section, the return feeders and cross bonding cables being 0·75 sq. in. and 0·15 sq. in. section. For the present scheme the quantities used are approximately —1 sq. in., 16,000 yards; 0·75 sq. in., 2,600 yards; 0·5 sq. in., 1,500 yards; and 0·15 sq. in., 8,000 yards. This entailed the making and fixing of 4,500 joints. The positive cables have a protective creosoted wooden trunking split on the centre line, grooved to fit the respective cables and screwed together. The cables are laid at sleeper level, but at stations and crossings they are laid in troughs and filled in solid with bitumen. All the negative cross bonds are insulated with vulcanised bitumen, and laid on the surface of the track, clamped to the sleepers, and protected from injury from platelayers, etc., by wooden fillets on each side of the cable. A cross section of a cable is shown in Fig. 32. The firm have also supplied the whole of the cables for the train equipments, comprising approximately 9,000 yards of 61 cores, each of 7/23 S.W.G.; 1,500 yards of 37 cores of 7/21 S.W.G.; 9,000 yards of 8 cores of 19/26 S.W.G. flexible cables; and 70,000 yards of 7/22 S.W.G.

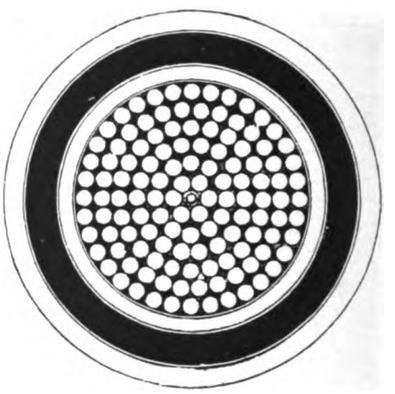

Fig. 32.
Section of Low-Tension Feeder.

The Track Work.

The railway track work involved in the electrification comprised the laying of a third rail and the bonding

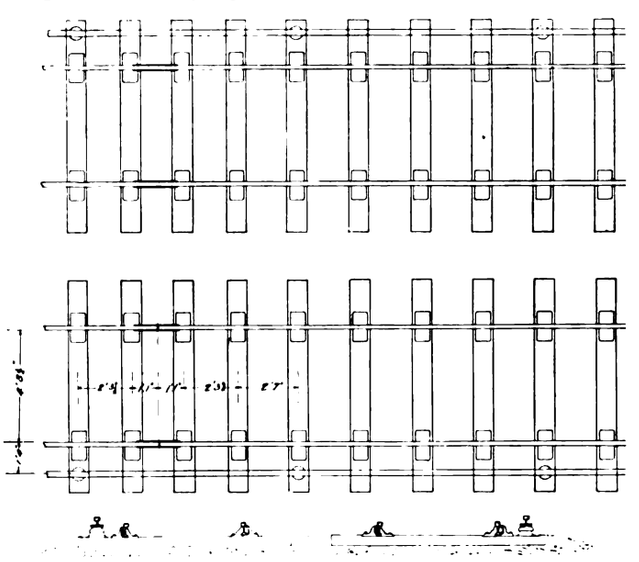

Fig. 33.—Plan and Section of Double Track showing Positions of Conductor Rails.

of the running rails of about 150 single track miles, The reason why there is such a great length measured as single track when the route length is only 47 miles, is made plain from the following facts. At the Waterloo terminus no fewer than twelve platform tracks are

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electrified, six on the main line side and six on the Windsor line side. From Waterloo to Clapham Junction, a distance of nearly three miles, there are eight tracks electrically equipped. From Clapham Junction four electrified tracks go off as the Windsor line, and four go on through Wimbledon as the main line.

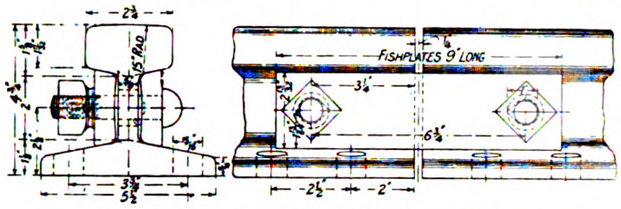

Fig. 34.—Dimensions of Conductor Rail.

Further out and on the branches the railway is simply double track.

The conductor, or third rail, is laid at one side of the track, 16 in. from gauge and 3 in. above track rail level (Figs. 33 to 36). It is of special high conductivity steel, and weighs 100 lb. per yard. Its electrical resistance is approximately 6¾ times that of copper of equal volume. It is bent down at the ends (where short gaps occur) to form ramps. There are four copper bonds per joint, having a total cross section area of 1·4 sq. in. The third rail is carried on malleable iron caps, which are supported on porcelain insulators. The jumper cables, connecting adjacent lengths of conductor rail at crossings and other points where it is necessary to leave a gap in the rail, are of 1 sq. in. sectional area, and are made up of one hundred and twenty-seven ·101 in. diameter copper wires insulated with rubber, bitumen sheathed and braided. The return circuit is formed by the running rails, the joints of which are bonded with two copper bonds of the protected type placed under the fish-plates. These bonds are made up of copper strip, and have a total cross-section area of ·33 sq. in. The running rails are cross-bonded at frequent intervals to equalise the current returning by the different rails. The conductor rails were supplied by Bolckow, Vaughan and Company, Limited, and the North Eastern Steel Company, Limited.

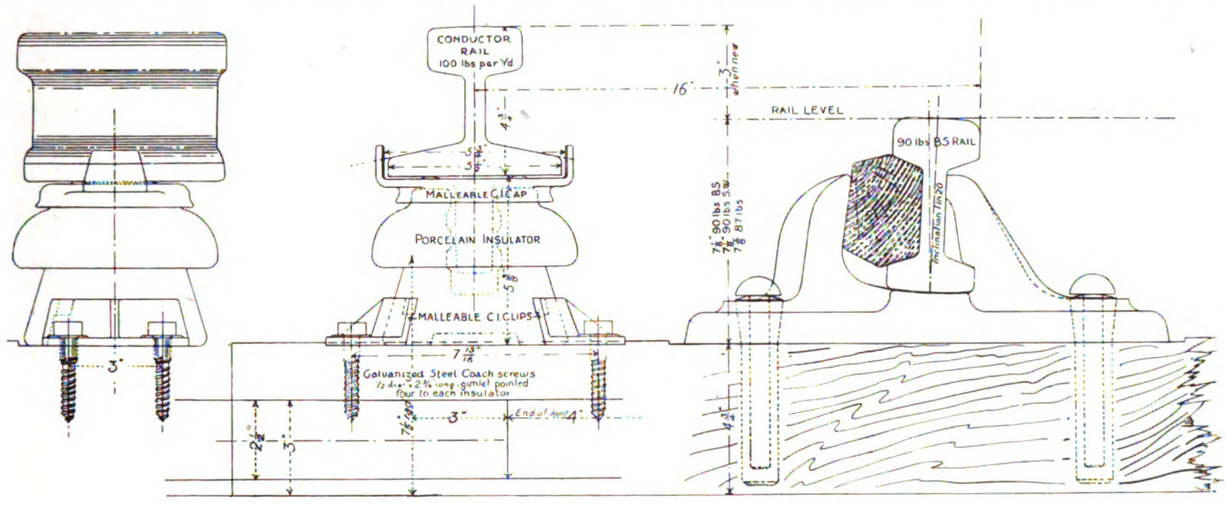

Fig. 35.—Track and Conductor Rails and Insulators.

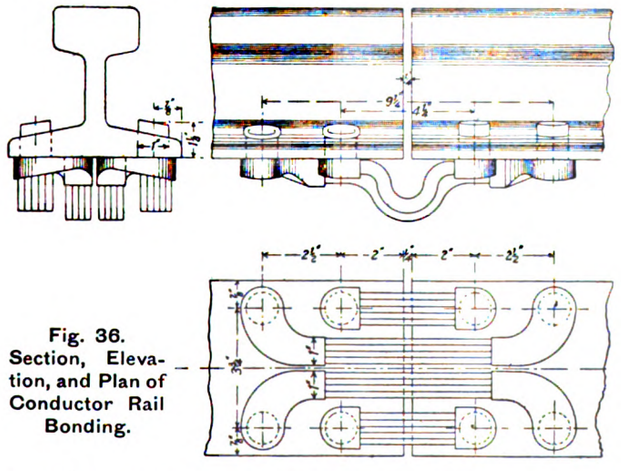

Fig. 36. Section, Elevation, and Plan of Conductor Rail Bonding.

As already indicated, automatic signalling is employed at junctions and other points. Before the electrification work began a signalling system of this sort was employed, but continuous current was used in the track rails for working the signal apparatus. The running rails are, however, now used for the return traction current, so that it became necessary to substitute alternating current for the signalling track circuits. The 75-cycle single-phase current previously referred to is used, and it is superimposed, so to speak, on the continuous current in the rails. The signal apparatus designed for the alternating current is, of course, unaffected by the continuous current. For signalling purposes the running rails are divided into

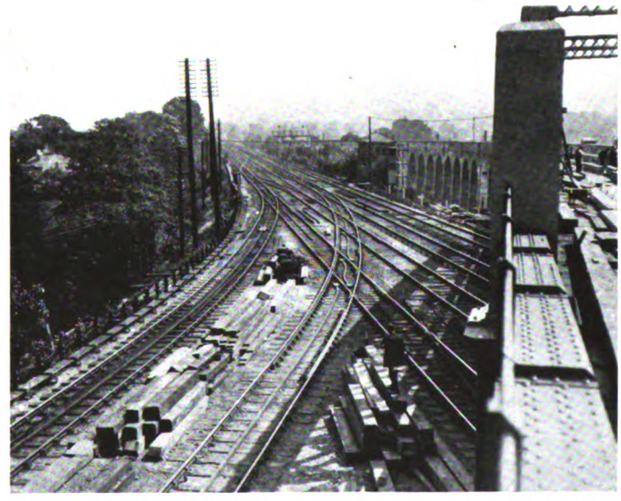

Fig. 37.—Hampton Court Junction Fly-Over.

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Fig. 38.—End View of Motor Coach.

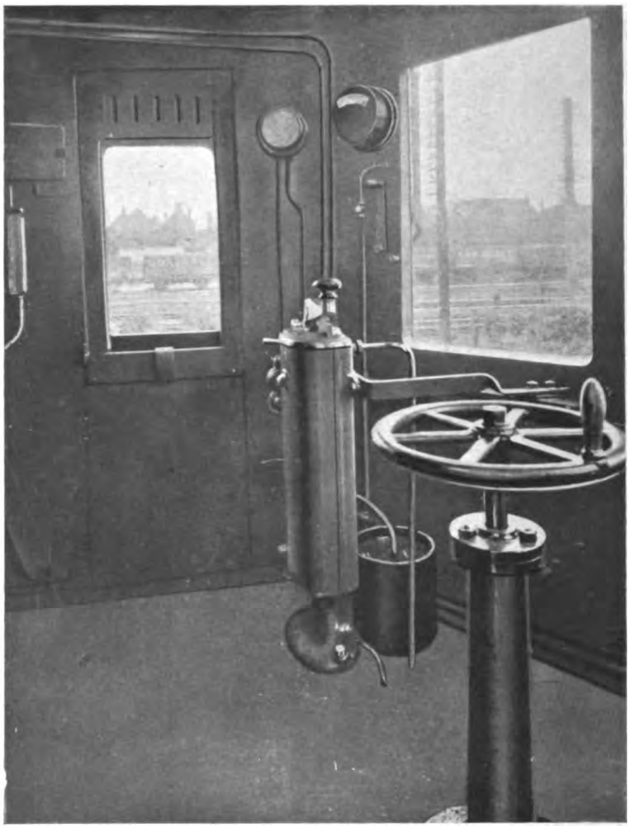

Fig. 39.—Driver's Cab showing Master Controller.

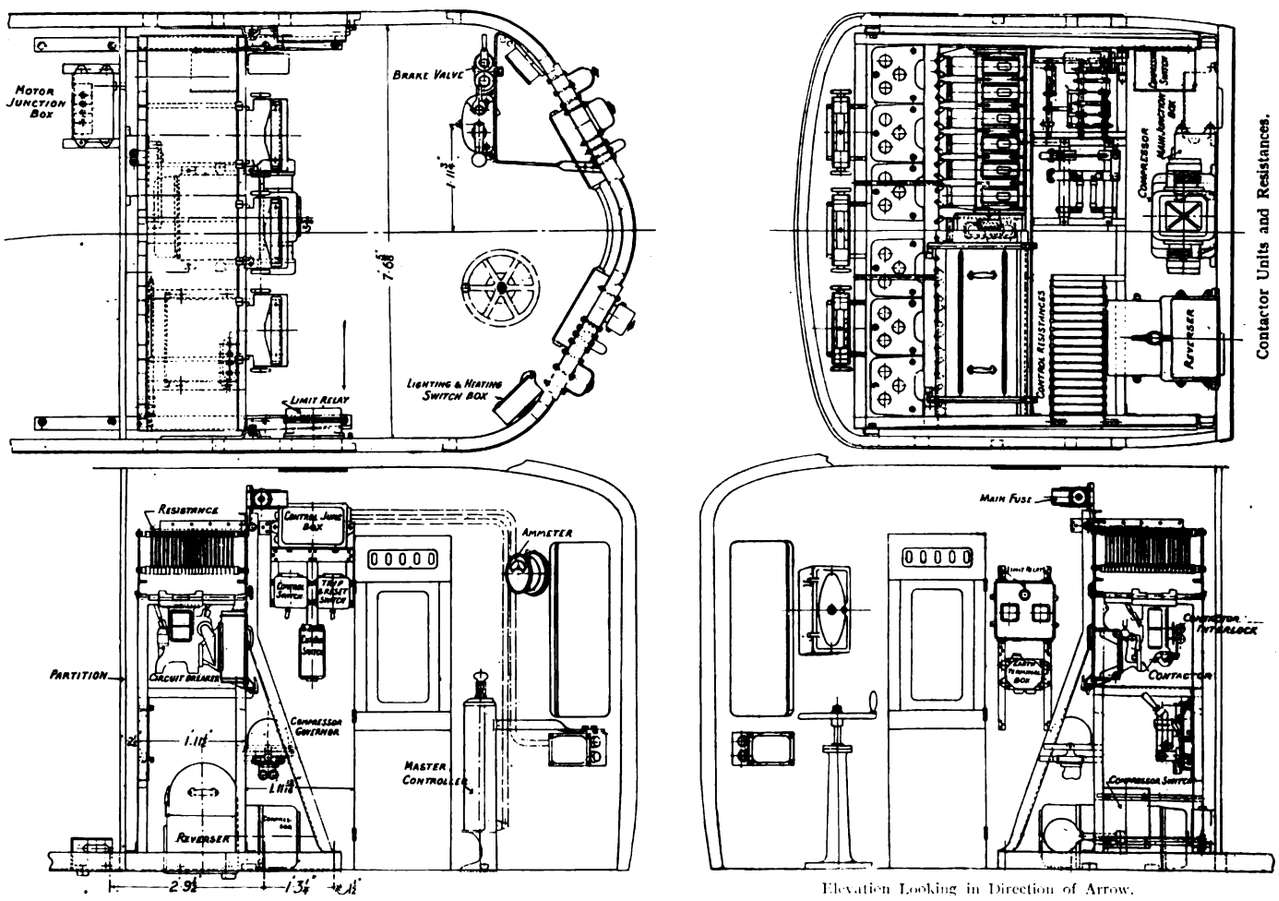

Fig. 40.—Plan and Elevations showing Arrangement of Equipment in Driver's Cab.

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electric sections, and at these divisions inductive bonds are used, which allow the direct current to pass but not the alternating current. The system of signalling is that of the McKenzie, Holland and Westinghouse Power Signal Company, and is similar to that used on most of the London underground railways.

An interesting piece of new railway construction work was carried out in connection with the electrification. It consists of a fly-over junction at Hampton Court Junction, and a view of it is given in Fig. 37. The necessity for trains on one of the tracks crossing the other tracks on the level when diverging is thus removed, and a more frequent service can accordingly be given. It may be remembered that a fly-over junction for the same purpose was recently constructed at Earl's Court on the Metropolitan District Railway. The Hampton Court fly-over involves a new line 1½ miles long, part of which is on a steel girder bridge of 160 ft. span. This carries the track over the existing lines. Part of the new line is also carried on two brick viaducts, 330 yards and 100 yards long respectively.

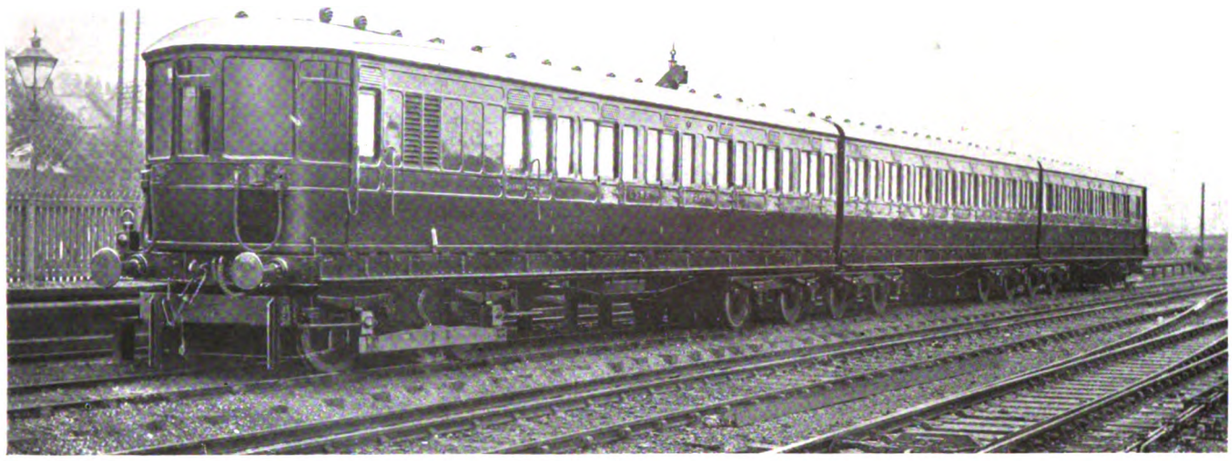

Fig. 41.—Three-Coach Train Unit.

The Rolling Stock.

The electric rolling stock consists of 252 compartment-type coaches, each 51 ft. long, until recently used in steam service, and now converted for electrical working. The electrical equipment was supplied by the British Westinghouse Electric and Manufacturing Company. Views of the trains are given in Figs. 38 and 41.

The trains are equipped for multiple unit working, and for convenience in handling are made up of 3-coach units, consisting of two motor coaches with a trailer coach close-coupled between them. The individual 3-coach units are intended to be permanently coupled, and form convenient and handy units for traffic. It is intended to operate these units as three- or six-coach trains, depending upon traffic requirements. A three-coach train weighs 94 tons empty, and seats 190 passengers.

Each unit is equipped with four 275 H.P. motors, 590 revolutions per minute, geared 21/59 on standard

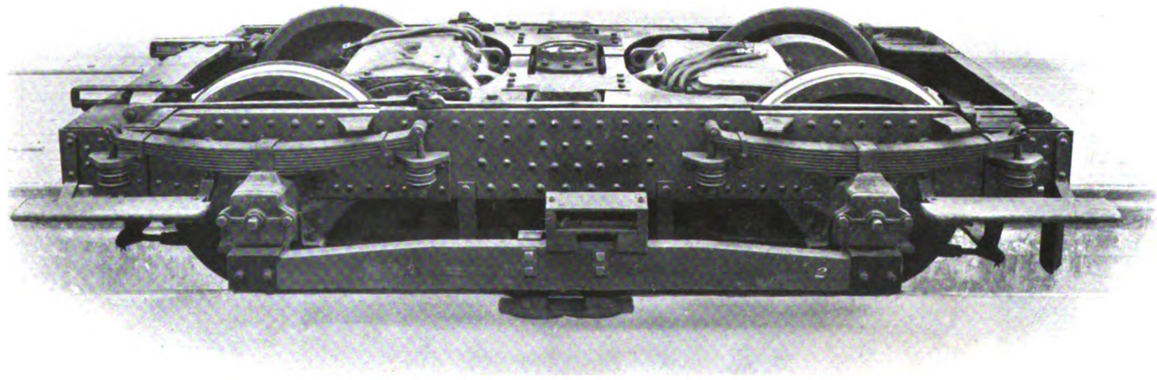

Fig. 42.—Motor Truck with Motors in Position.

42½ in. driving wheels; these motors are arranged in pairs on the bogies underneath the driving compartments at opposite ends of the unit. A view of an equipped motor truck is given in Fig. 42. All the electric control gear is placed in these compartments, each pair of motors being controlled by its own set of control gear. The arrangement of the control gear in the driver's cab was decided upon by the railway company's engineers in preference to having it underneath

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the coach on account of the greater ease of access for inspection, cleaning, and adjustment. The positions of the individual pieces of apparatus have been carefully arranged with this end in view. Access to the control apparatus is obtained on the one side from the driver's compartment and on the other through large hinged doors in the partition between the driver's and luggage compartments. There is an advantage in placing the control apparatus in the driver's cab in that the weight of this apparatus comes over the driving bogie and so increases the adhesive weight on the

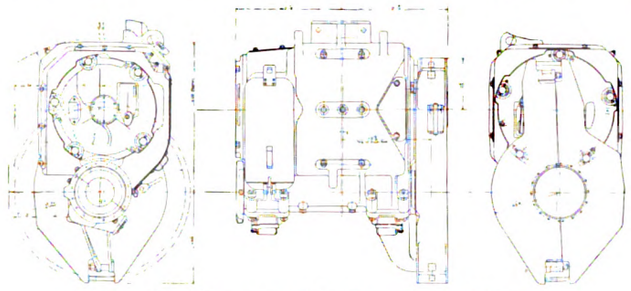

Fig. 43.—Plan and Side Elevations of Motor.

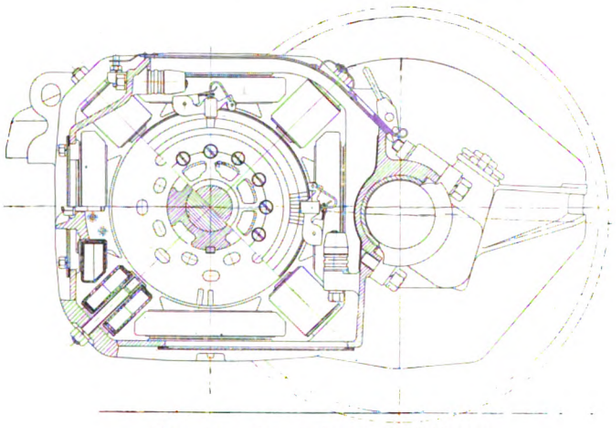

Fig. 44.—Cross Section of Motor.

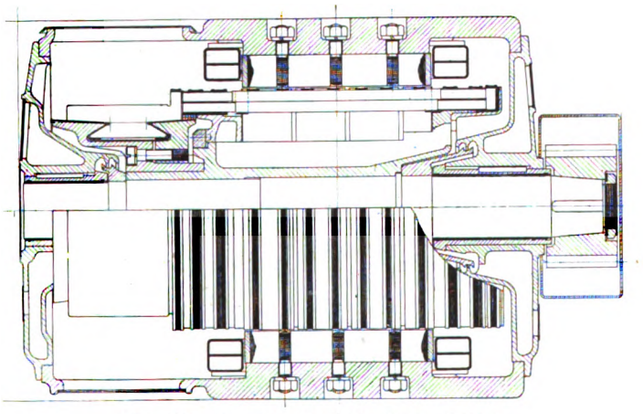

Fig. 45.—Longitudinal Section of Motor.

driving wheels. The arrangement of the apparatus in the driver's cab is shown in Figs. 39 and 40.

Motors.—The history of the development of railway motors has been one of steady improvement, and the construction of the motor adopted for this scheme is the direct result of a vast amount of experience, experiment, and close attention to details. When dealing with large railway motors, the restrictions in design are very great on account of the small space available and the severity of the operating conditions, so that nothing but the most rigid form of construction will withstand the service. Rugged construction has consequently become one of the most important considerations in design.

The motor is a series-wound totally-enclosed machine, the characteristics of which, as is well known, are most particularly suited to traction services of this kind. It has four poles with four sets of field coils, four commutating poles, and two sets of brushes. Many details may be gathered from Figs. 43 to 48.

As is usual with large motors, the box type frame is used. The bearings are carried in end housings, and

Fig. 46.—General View of Motor.

Fig. 47.—Armature of Motor.

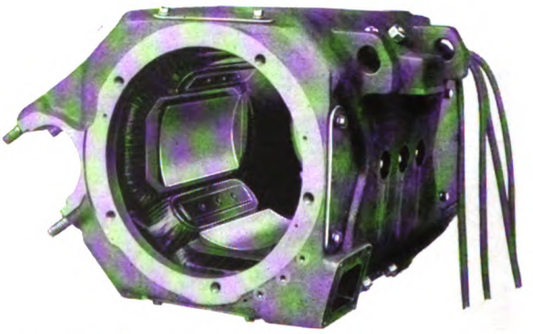

Fig. 48.—Motor with End Casting and Armature Removed.

the motor is equipped with commutating poles. The difficulties met in machining the box type of yoke are overcome by the use of specially designed machine tools. As an illustration, it is essential for the pole bolt holes to be very accurately spaced, but the necessary accuracy could not be guaranteed if they were drilled from the outside. Special machine tools were therefore designed, by means of which the bolt holes are drilled from the inside of the yoke with perfect mechanical spacing. Another machining difficulty which has also been satisfactorily overcome by the use

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of special machine tools is the planing of the interpole seats which lie, as it were, in the corners of the box type frame. The universal use of special jigs and gauges in the manufacture of these motors ensures perfect accuracy and interchangeability. The field poles are laminated, and the interpoles are made solid and have a special shape of tip. Spring washers are used in both cases to keep the coils firm in their places and to prevent chafing due to vibration.

The design of the armature embodies strength, compactness, and solidity of construction. A fan is provided on the armature for air circulation on the axial system. Air drawn through openings in the commutator spider and armature core passes through the fan and back between the field coils and over the armature and commutator. Openings to the atmosphere are not provided, the whole of the cooling being done by straight radiation from the case, but the circulation of air ensures even temperature throughout the motor.

The construction of the brush gear is very rigid ; the holders themselves are substantial bronze castings, and are clamped to the machined face of the casting, which is supported by two insulated rods bolted to the motor frame. The insulation is of pure mica directly surrounding the rods, which are forced into their place in the casting by a considerable pressure, the mica being protected during this process by hardened steel split tubes. The completed holder with its insulated supports is subjected to a mechanical test of some 40 tons to ensure that the rods with their insulation are properly secured to the holder. The brushes are arranged for radial adjustment to allow for wear of the commutator, and are readily accessible for inspection and adjustment through the commutator trap door.

The lubrication of all bearings is effected by means of long fibre wool waste, which syphons the oil up to the bearings, and provides a continuous and automatic supply. A separate oil reservoir permits the fresh oil to be fed and filtered up through the waste to the bearings. Suitable oil wiper rings and guards prevent the oil from the bearings getting into the motor casing. The oil thrown from the wiper rings passes to a waste pocket of ample capacity in the bearing housing, from which it may be drawn off periodically. The motor casing is carried by a suspension bracket, which is supported through rubber springs from the truck transom. The spur-wheel gears and pinions between armature shaft and car-wheel axle were supplied by Scholey and Company, Limited, and are of that firm's special tool steel type. Various references have been made in these pages to the special features of this gearing, but it is notable that in point of size the gears are probably the largest in use on any railway, the diameter being 30½ in. An idea of the size is given in Fig. 49, which shows a South Western gear in the middle. On the right is an ordinary tramway gear and pinion, and on the left a gear and pinion used on high speed interurban railways in the United States. Tool steel gears and pinions are particularly well adapted for railway service by reason of the extremely large mileage which can be offered.

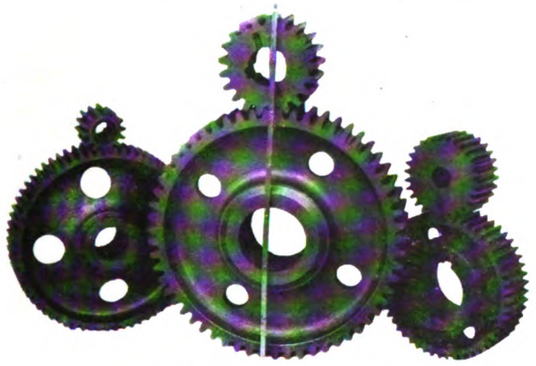

Fig. 49.—Comparative Sizes of L. & S.W.R. and other Gears.

Control Apparatus.—The control of the trains for multiple unit working is effected by the Westinghouse Company's "all electric" system of automatic relay control. In this system the motor current is handled by a suitable number of electrically-operated contactor switches, the operating coils of which are connected to control wires running throughout the length of the train and actuated by a small master controller. The contactors are provided with interlocking switches connected in their operating circuits to ensure the correct sequence of changes in the connections.

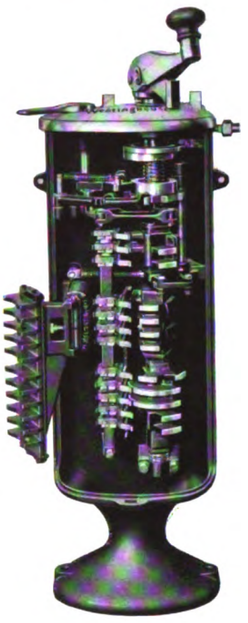

Fig. 50.
Master Controller with Cover Removed and Arc-Shield.

The motor equipment on each coach is controlled during the accelerating periods by its own relay, which is independent of the other relays on the train ; hence the motors on the different coaches are notched up in accordance with their individual requirements, which are, in a measure, dependent upon the diameter to which the wheels may be worn and the slight inherent differences in the characteristics of the motors. This system therefore helps to equalise the load on the different motor coaches, and gives a low energy consumption.

Fig. 51.
Single Contactor Switch.

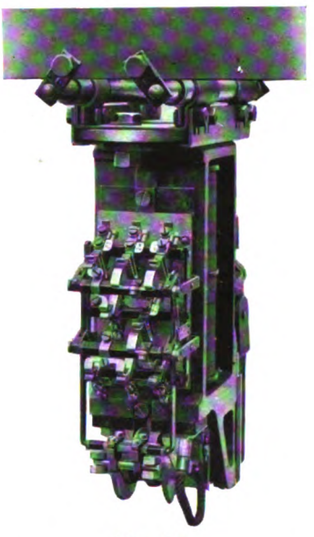

Fig. 52.
Rear View of Single Contactor Switch showing Interlocking Switches.

With this system the master controller (Fig. 50) becomes a very simple piece of apparatus, and this is important, because it is the only piece of apparatus handled by the drivers, who are generally non-technical men. The operation of the controller is extremely

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simple, the driver having merely to move the controller right round to the full " on " position, and the relays automatically do the rest. Powerful magnetic blow-outs are fitted to all pieces of apparatus where there is a possibility of arcing when breaking current. The arcing tips are of hard-drawn copper, which can be easily and cheaply renewed. A wiping action between the contacts is provided, so that any roughness due to arcing when opening the circuit does not interfere with the contact surface when the switch is in the closed position.

Each contactor (Fig. 51) and circuit breaker is carried by a pressed steel plate clamped to mica insulated steel tubes, which are fixed to two channel irons running the full length of the switch group. This method of construction is light and strong, and has the necessary flexibility to withstand vibration. It also renders the withdrawal and replacement of a contactor switch an extremely easy matter.

The interlocking switches (Fig. 52) mentioned above are fixed at the back of the contactor switches, and are operated by a lever from the movable core of the contactor solenoid, thus ensuring a definite position of the interlocking switch, corresponding with a definite position of the contactor. These interlocking switches have been most carefully designed with a view to ready inspection, renewal, and withdrawal when necessary. The smallest possible number of different parts is used in the construction.

The frame carrying the contactor switches forming the motor car group lies across the width of the coach in the driving compartment. It also carries the necessary motor starting resistances and the main fuse above the contactors. The motor resistances are of the usual three-point suspension grid type, mounted on mica insulated tie-bars fixed to pressed steel end frames, giving a strong and rigid construction. Views of the back and front of the switch group are shown in Figs. 53 and 54, from which may clearly be seen the interlocks at the back of the switches and the arcing tips and arcing

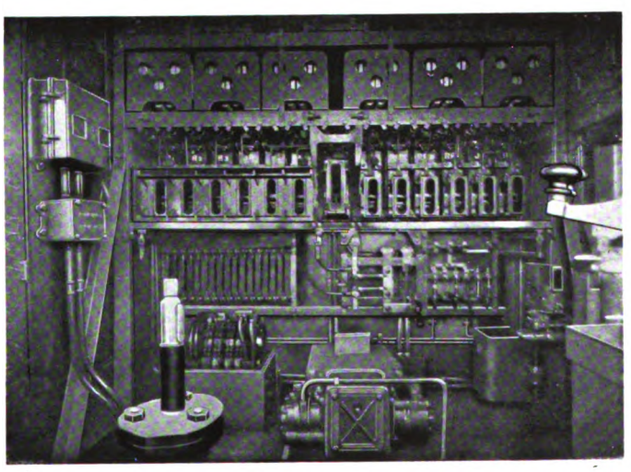

Fig. 53.—Front View of Contactors in Driver's Compartment.

boxes at the front of the group. The circuit breaker is similar in construction to the contactor switches, and may be seen in the middle of the group. It is provided with heavy laminated brushes in addition to the contact jaws, and adjustable overload and trip coils.

The reverser (Fig. 55) is of the drum type. The drum castings are clamped to mica insulated shafts provided with heavy copper contact segments. The fingers are made with renewable tips, and provided with swan-neck finger springs and heavy copper shunts. The finger bases are clamped to mica insulated bars. The interlocking of the control circuits for operating the reverser is effected by an additional contact drum attached to the main spindle, so that a fixed relationship between the making and breaking of the main control circuits is obtained. A powerful magnetic blow-out is provided for the interlock fingers, which are identical with the swan-neck fingers used in the master controller.

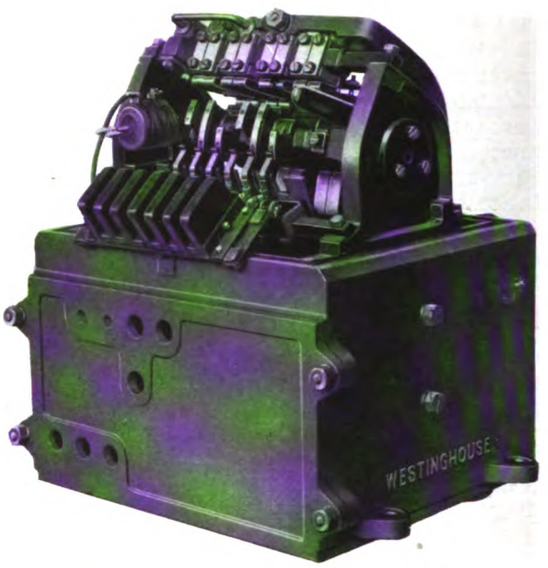

Fig. 55.—Reverser with Cover Removed.

The master controller is of the drum type, and is provided with both main and reversing handles, so interlocked that the reversing handle must be either in the forward or reversed position before the driver can operate his controller. The main handle embodies

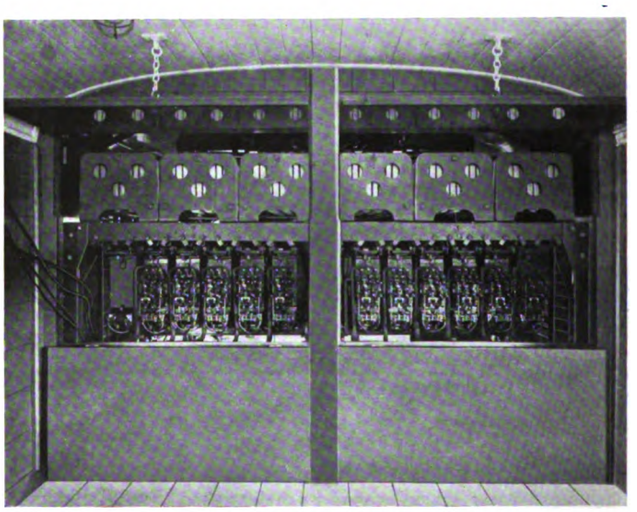

Fig. 54.—Rear View of Contactors.

the " dead man " feature, the arrangement being such that in the event of the driver releasing the handle the supply of control current is interrupted, thus opening all the main contactors, and the brakes are automatically applied. Should the driver allow the handle to move upwards at any time, he must bring the operating handle to the " off " position again before he can release the brakes. When coasting and when making ordinary service stops the driver moves the main handle to the " off " position and keeps his

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hand on the handle, thereby preventing the interruption of current and the automatic application of the brakes.

The main handle of the master controller has four operating positions :—The first position, usually called the "switching" position, gives series connections to the motors with all resistance in circuit ; the second position brings the automatic relay into operation, and the resistances are cut out of circuit step by step until full series is obtained ; the third position connects

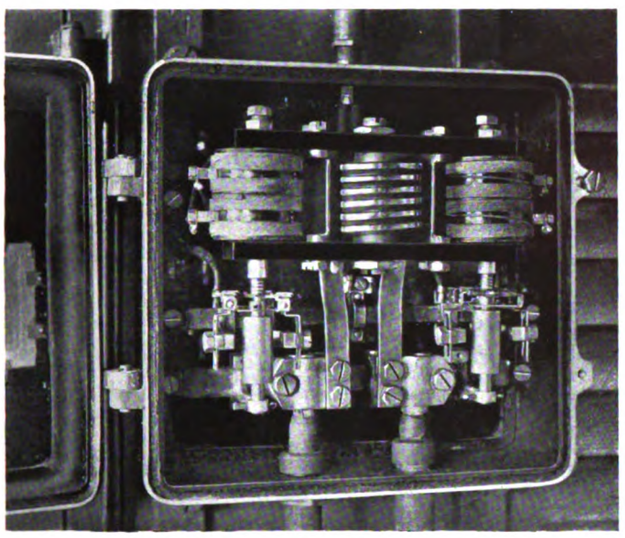

Fig. 56.—Automatic Current Limit Relay.

the motors in parallel, the well-known bridge connection being used in passing from series to parallel ; the fourth position brings the automatic relay into operation again, cutting out the resistance step by step until full parallel is obtained. It is unnecessary to pause on each notch of the controller until the corresponding motor connections are completed, but the handle may be moved directly to either the series or parallel

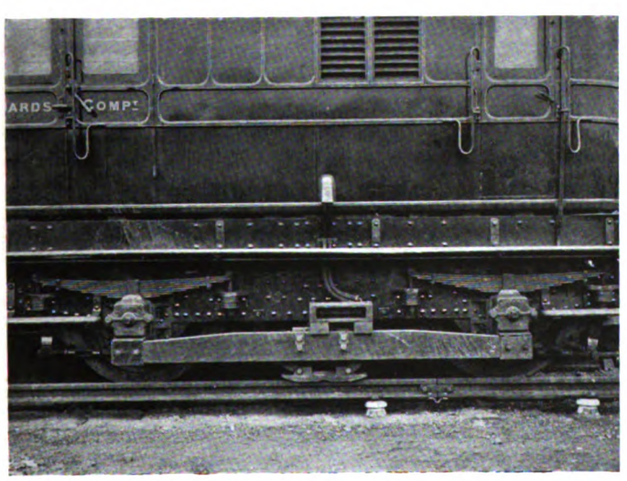

Fig. 57.—Contact Shoe, Beam, Fuse Box, and Leads.

positions, when the control apparatus automatically notches up step by step until the position is reached corresponding to the particular notch on which the handle is placed.

The starting current, and therefore the rate of acceleration, may be adjusted by means of the setting of the automatic relay. This relay (Fig. 56) consists of three coils, two of which have movable plungers fitted with copper discs for bridging contacts in the control circuit, the three coils having a common magnetic circuit. The two coils which have movable plungers are connected in the control circuit, and the third coil is a heavy current coil connected in the motor circuit. The function of the two coils in the control circuit is to lift the short-circuiting copper discs, and thereby open one of the control circuits, the discs being held up until the motor current in the series coil has fallen to the pre-determined value for which the relay is adjusted. The contacts in the relay are never used for breakiug circuit, and are therefore not liable to cause trouble by burning.

The construction of the control apparatus throughout is of non-inflammable material, and the whole of the insulation is of mica.

The sliding shoe which collects the current from the conductor rail is shown in Figs. 57 and 58. Mounted on a teak beam, the face of the shoe is hollowed out transversely in the centre, so that there are two separate surfaces of contact. A fuse-box is placed in an easily accessible position above the wooden beam. It will be seen that the leads from the shoe are taken in at one end of this box and leave it at the other. They then enter the side of the car on their way to the control apparatus by a neatly designed tubular cover. Two

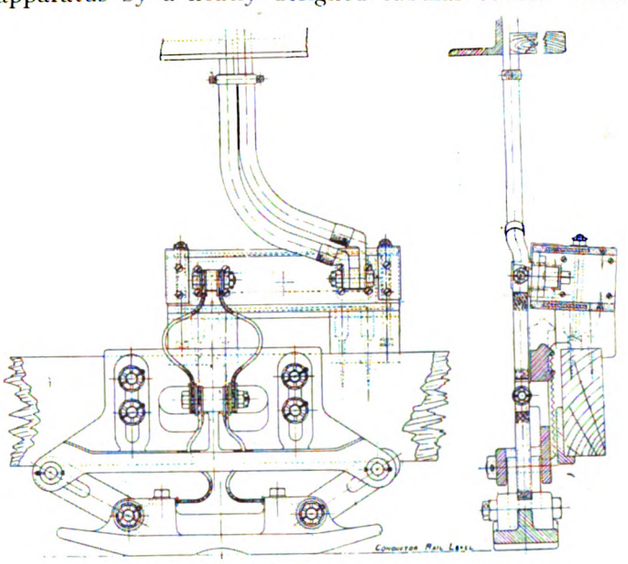

Fig. 58.—Plan and Elevation of Current Collector.

leads of standard size cable are employed instead of one of greater section. The fuse-box gives a means of cutting off the power in the event of a short circuit, in addition to the usual apparatus for that purpose in the driver's cab.

Practically all the wiring is in the driver's cab, and the connecting train wires and through shoe cable are fixed on the roof of the coach so as to be quite out of reach of unauthorised persons.

Lighting and Braking.—The lighting of the compartments has been the subject of very careful study by the railway company's engineers, and a suitable and tasteful fitting has been adopted. The coaches are heated by electric radiators suitably grouped in the various compartments.

The Westinghouse brake used on the electric trains employs cylinders 12 in. and 14 in. in diameter, and the triple valves are of the newest design, which pass on the operation of the driver's brake valve to the rear of the train by a quick serial movement, resulting in the almost simultaneous application of the brakes on a train 600 ft. long. The air is supplied to the brake system by small compressors direct-driven by slow speed motors, one of which is placed in each motor car.

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The action of all these compressors on a train is controlled by a master governor and switch, which produces uniform compressor labour throughout the train, as all compressors start and stop simultaneously. This arrangement is known as the Westinghouse governor synchronising system.

Car Sheds and Repairing Shops.—Views of this large building, which adjoins the power-station, are given in Figs. 1 and 60. It is 340 ft. long by 267 ft. broad, divided into five bays, and contains nine tracks running the full length of the house and six tracks part of the length, the latter being in the repairing shops. Eight

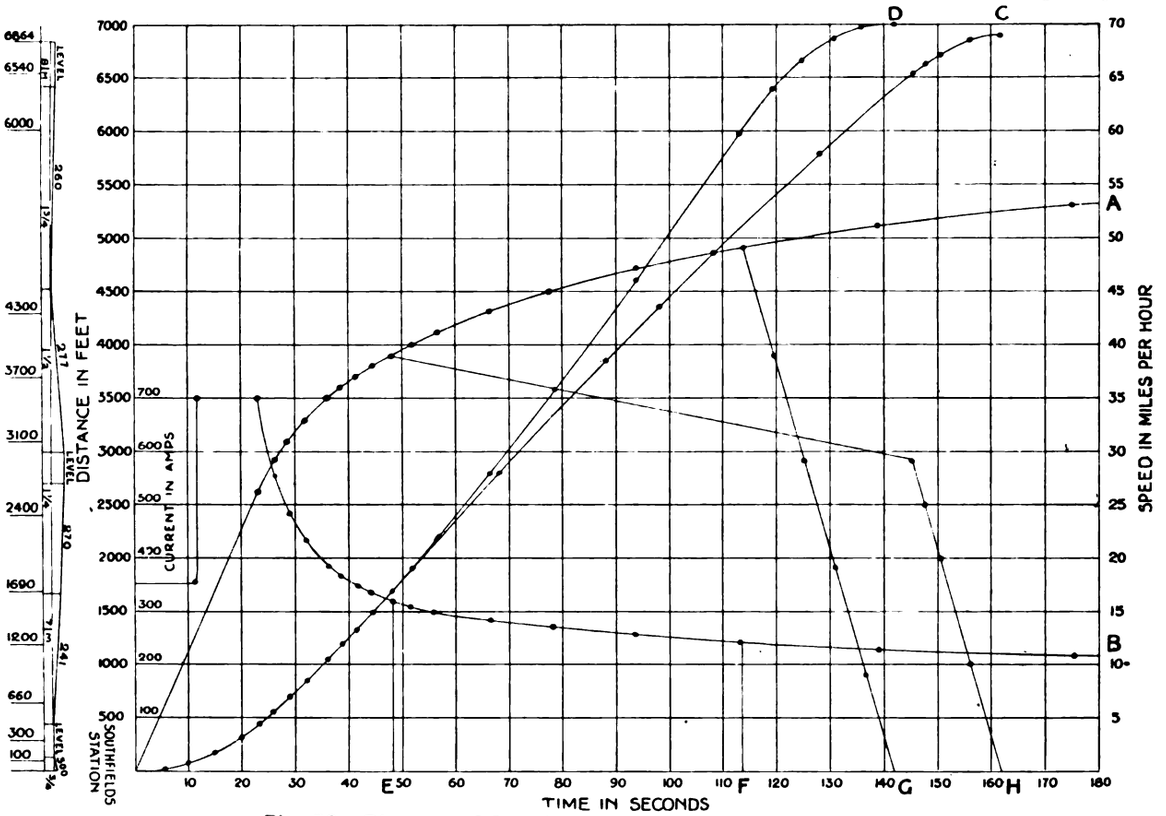

Fig. 59.—Diagram of Speed and Power Consumption Tests.

Train Performances.—Some time before the electric trains began running for public service, a series of tests were made with a three-train unit, some of the results of which are set out in the diagram (Fig. 59). A is the time-speed curve and B the curve of power consumption. In the first of two separate runs coasting

of the tracks have pits for inspection. The repairing shops are equipped with cranes and the usual tools, but extensive repairs to the car bodies will be carried out at the railway company's works at Eastleigh.

Traffic.—Preliminary time tables drawn up show savings in time as compared with the steam train

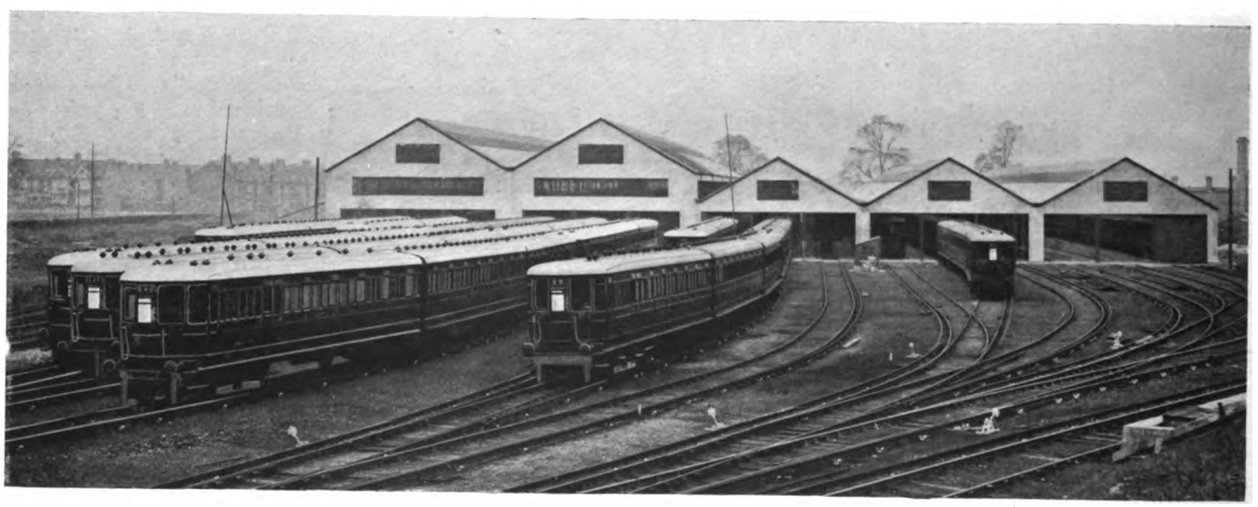

Fig. 60.—Entrance to Car Sheds and Repair Shops.

was started at time E, and on the application of the brakes the train was brought to rest at time H. In the second case there was no coasting, the brakes being applied at time F and the train stopped at G. Curves C and D are time-distance curves corresponding to the two runs mentioned.

speeds of 20 per cent. and upwards. As there are no second-class carriages, holders of unexpired second-class season tickets have been offered an arrangement for exchanging their tickets for first-class or third-class. In the former case the passenger pays the proportionate difference, and in the latter he is credited with it.

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An incidental result of the electrification is the disuse except for auxiliary purposes of the small power station of the Waterloo and City Railway. That line will now be supplied from the Wimbledon station through the sub-station at Waterloo. The plant in the power station now superseded included five "Economic" boilers, hand fired, and each capable of evaporating 7,000 lb. of water per hour. There were six high-speed three-crank vertical tandem compound engines of 360 H.P. each, driving bipolar dynamos with a rated output of 200 KW. each. The speed was 380 revolutions per minute. The working pressure on the third-rail conductor is about 550 volts, and direct feeding without sub-stations is employed, as the line is only a mile and a half long. There is no intermediate station so that the trains run right through. This line was opened for traffic in 1898, and has worked satisfactorily ever since.

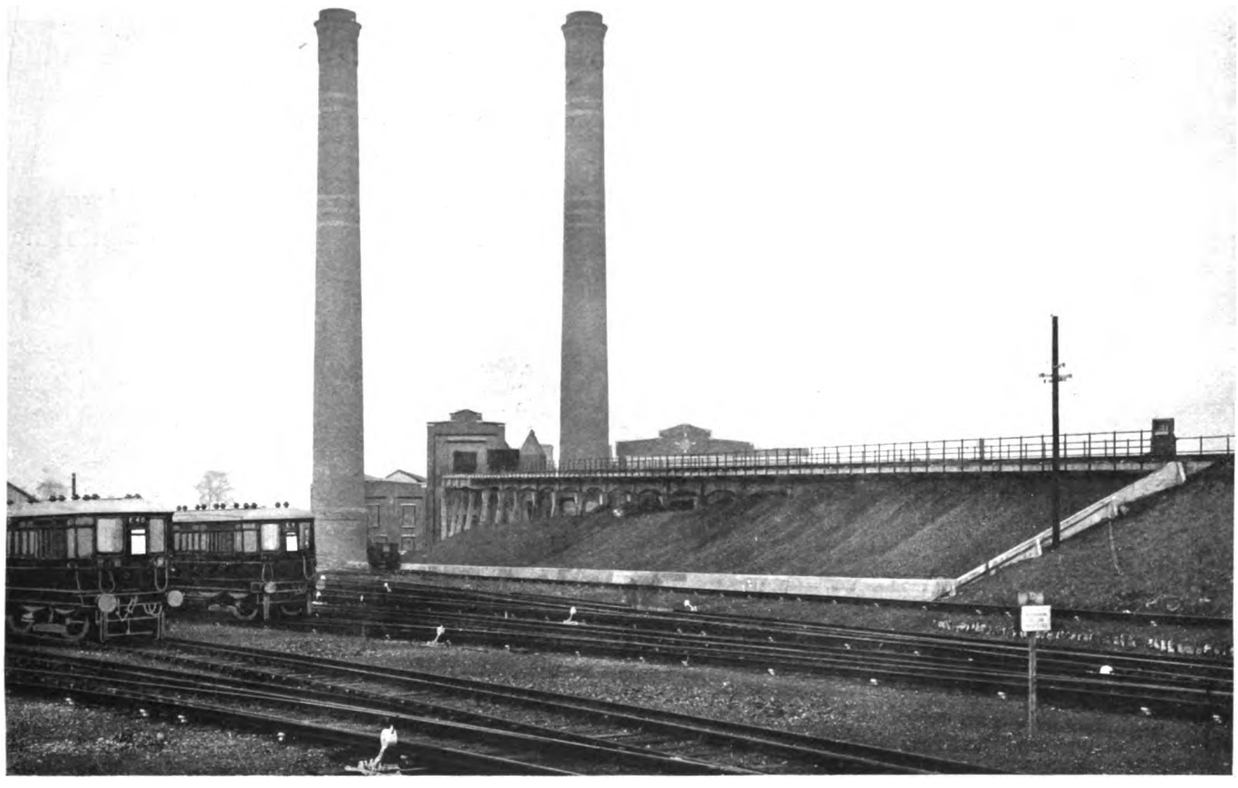

Fig. 61.—Viaduct to Coal Bunkers with Coal Storage below.

The officers of the London and South Western Railway Company who have been responsible for the whole of the suburban electrification scheme are :—

Sir Herbert A. Walker, the general manager, upon whose recommendation the scheme was adopted;

Mr. Herbert Jones, the electrical engineer, who was responsible for the entire scheme and for the carrying out of same;

Mr. A. W. Szlumper, the chief engineer, who carried out the permanent way work and signalling alterations;

Mr. S. Warner, the carriage and wagon superintendent, who carried out the alterations to the rolling stock; and

Mr. Henry Holmes, the superintendent of the line, who undertook the re-arrangement of the train service.

Messrs. Kennedy and Donkin, Westminster, were the consulting engineers.

ELECTRIC EQUIPMENT OF THE CHICAGO, MILWAUKEE AND ST. PAUL RAILWAY.

In our issue of February 11 last was published an illustrated description of the proposed electrification of the Chicago, Milwaukee and St. Paul Railway. The work has now been actively carried on for some months, since the order for equipment was placed with the American General Electric Company in September, 1914. In view of the magnitude of the scheme the progress made to date has been remarkable, and in our next issue we hope to publish a further description which we have received through the courtesy of the British Thomson-Houston Company. It may here be mentioned that the overhead construction, which includes 650 miles of single track, has been completed for a distance of more than 200 miles. The 100,000 volt transmission line which parallels the electrified tracks has been completed for an equal distance, and the tie-in lines from the 100,000 volt system to the Montana power station are ready for service. Seven sub-stations designed to supply power to the first half of the 440 miles of route have been completed, and the electrical equipment is being rapidly installed.

The first of the forty-two 282-ton locomotives required was placed on the test tracks early in September, and it was shipped on September 25. This machine is now being exhibited at various points on the Chicago, Milwaukee and St. Paul system. The tests indicate that the locomotive will surpass the expectations of the designers. Twelve of the locomotives on order are geared for passenger service, and the remaining thirty for goods service. Both types are equipped for regenerative braking, the apparatus being under the control of the driver.

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THE
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South Western Railway Electrification.

We devote considerable space in this issue to a description of the equipment and work involved in the conversion to electric traction of the whole of the suburban lines of the London and South Western Railway. This is one of the greatest schemes of electric traction which has yet been executed in this country, and the railway company are to be congratulated on their success in carrying out the work with so little delay in spite of the exigencies arising out of the present war. The engineers have provided excellent general designs, which embody a number of features of unusual interest, as may be gathered from the illustrations and description. All of the principal electrical contractors to whom the work was entrusted are British firms well known to readers of our advertisement pages from the early days of electric traction, and they may justly take credit to themselves for the completion of a fine example of modern railway equipment in a period of unprecedented difficulty. That so extensive and important an undertaking has been carried through in the stress and preoccupation of the war is a notable proof of the resources of the country. Three outstanding features may here be mentioned—the substitution of a suction plant for a coal and ash conveyor in the power-station, the placing of the contactors and all the other train control mechanism in the driver's cab, and the automatic notching up of the control for the purpose of acceleration. Following the practice which is general in this country—the sole exception in the London area being the London, Brighton and South Coast Railway, which uses the alternating current system—the South Western Railway employs the well-tried direct current method with a third-rail conductor. The whole of the company's suburban lines are not yet working electrically, but they soon will be. The advantages both to the company and to the public will be very great. The former may expect to carry a greatly increased number of passengers and to secure a much larger net revenue, while the latter will have the advantage of much more frequent and more speedy trains. The development of traffic likely to arise can hardly be calculated, but the proper cultivation of a field which covers a large part of the Thames valley ought to produce most lucrative results.

Power for Multiple-Unit Trains.

Surprise may sometimes be occasioned by the great differences in the power of motors used on electric railways, but on examination it will be found that it is all a question of the weight to be hauled. For example, each of the new electric trains of the London and South Western Railway suburban service has four motors aggregating 1,100 H.P. The train consists of three cars, one of them being a trailer. Similarly the three-car electric trains of the London and North Western Railway running between Earl's Court and Willesden have each four motors of a total of 1,000 H.P. On the other hand, on the London "tube" railways, where the three-car unit consists of a motor car and two trailers, the motors are rated in all at 500 H.P. An intermediate stage is found on the Metropolitan District Railway where motor cars and trailer cars are equal in number on each train. Here we have 500 H.P. per two cars—one motor and one trailer. The reason for all this is that the carriages on the South Western and North Western Railways are much larger and heavier than those on the other lines mentioned, and

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that per train there is also a much greater weight of electrical equipment. At the same time it is safe to say that with 1,100 H.P. on a three-car train the South Western Railway suburban services should provide some surprises, both as to acceleration after stops and as to running speed, to those who have been accustomed to their steam suburban trains.

The Need for a Traffic Board.

We regret that the Council of the Municipal Tramways Association did not take steps to increase the number of visitors at the recent conference by sending an invitation to the Commissioner of Police for the Metropolis. If that gentleman had been present he would have witnessed the feeling of amusement which the great provincial centres manifested towards the bureaucratic system under which one or two officials do their best not only to strangle tramway development but to interfere in the affairs of people with whom they have no concern. As is usually the case in such instances, the meddlesome department neglects one of the objects for which it was created, viz., the prompt licensing of the men who have been selected by the managers to work the vehicles. In refusing until the end of October to permit the Metropolitan tramway undertakings to employ female conductors, the police put forward three reasons that cannot by any possibility come within the scope of their duties. First, they told the managers to turn their attention to discharged soldiers. When no ex-soldiers fit for the work were forthcoming, the police became the advocates of a trade union, in ignorance of the fact that all over the country the unions have assented to the temporary employment of women as conductors. At the same time, the stage carriage licensing department invaded the domains of the Admiralty and the War Office by expressing the absurd opinion that the traffic undertakings had given as many recruits to the services as might be expected. While thus interfering, the police have taken an unreasonable length of time to issue licences to men sent to them by tramway managers, who have been harassed by prosecutions on putting them on their cars. The truth is that Scotland Yard has been encouraged to ride the high horse by the steps its chief was allowed to take in the case of the regulations made five years ago for the construction of new and the improvement of existing omnibuses. Those regulations have left a beneficial mark upon omnibus construction and operation throughout the country, but success was attained because the regulations were framed by an automobile engineer, who no doubt had taken the precaution of consulting manufacturers and operators. This incident is the greatest justification for the plea that the whole of London's traffic business should be placed under the control of experienced men forming a Traffic Board, as recommended by a Royal Commission a decade ago and by a Parliamentary Committee in the autumn of 1913. The war constitutes no reason why the recommendation should not be carried out. On the contrary, the restricted lighting and the increasing number of accidents to pedestrians strengthens the case, for it was due to the mishaps in the streets that the Parliamentary Committee was appointed. Another reason why the Board is necessary is that Scotland Yard has just figured again in opposing not only new tramways but reconstruction. With singular blindness to the truth the mouthpiece of the Commissioner has again succeeded in making him look ridiculous in the presence of Parliamentary Committees. The statements were made that it was more difficult to regulate traffic in streets containing tramways, that the introduction of tramways was always followed by a general increase in traffic, and that one street in which a tramway is to be electrified is a costers' market. It is self-evident that tramway traffic conduces to the marshalling of other vehicles, and what are the streets for but for traffic? Costers are trespassers competing with tradesmen, and they should be removed to quieter thoroughfares. We are not surprised that the arguments failed to impress the House of Lords' Committee. Doubtless the members had not forgotten the indefensible position taken up by the same department when trail-car powers were applied for. How great an advantage the trail-cars are to the country in the war crisis need not be dilated upon. If Scotland Yard had not succeeded in curtailing the first experiments the trailers would have been trebled in number by this time.

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The Bully of the Road.

The feud between the motor-car and the tramcar on the question of road obstruction is a long-standing one, but we were under the impression that it had subsided into some approach towards a truce. Certainly we did not expect that it would be revived in an aggressive form at a time when every form of transport is operating under difficulties in the service of the nation at war. It is this very time, however, that a motor contemporary choose to denounce the tramcar as "the bully of the road." One contemporary begins by delivering a *tu quoque* against the electric tramcar advocates who are alleged to have stated that the motor 'bus is the bully. "One characteristic of a bully is to hit his opponent unawares, and preferably from behind. Electric tramcars, certainly in London, fail in these very regards, either from ineffective braking or from careless driving. They run into other vehicles, from behind, very often." There is a certain vagueness about the words "very often," but it is asserted that the records of insurance companies show a higher percentage of running-down cases in which electric tramcars are concerned than they do of similar collisions between any ordinary types of road vehicle. Now, there is nothing to be said against the braking power of London tramcars; it is sufficient, when suddenly applied, to fling the conductor from one end of the car to the other. And it is absurd to suggest that tramcar drivers are careless about running down vehicles from behind; they themselves would be the first sufferers in any serious collisions from such a cause, and the other penalties imposed on recklessness are severe enough. At the same time, it is readily understood that a vehicle confined to rails must be at a disadvantage in adjusting its position with regard to a vehicle which is free to move in any direction and suffers from an apparently incurable passion for the tramway track itself. We have no desire to fix the term "bully" upon the drivers of motor omnibuses, but when a man is in control of a mobile vehicle with a high-speed capacity he is not likely to be tender of the feelings of other drivers in his efforts to complete journeys in a schedule time which demands frequent spurts and great enterprise in manœuvering. His inevitable tendency is to let vehicles in the rear take care of themselves when he is called upon to make a sudden stop for a passenger, or when he finds that he has to pull up sharply to avoid some obstruction. If the following vehicle is a free one, it can—and does—escape collision by drawing to one side, but this dodging is not within the ambit of a tramcar. Possibly the motor view of this inability is that it is "so much the worse for the tramcar," but a more reasonable attitude is that the motor omnibus driver on a tramway route should exercise particular care and endeavour to forget that he is a competitor of the tramcar driver. Now that a move is on foot to reduce the duplication of road passenger services in London, the sporting proclivities of drivers may be slightly subdued. Mutual accusations of bullying are not, so far as we are aware, heard in relation to those districts where the motor omnibus and tramway services are already co-ordinated with a view to giving the public an adequate service without overlapping or any of the other drawbacks of destructive rivalry. If bullying of the kind suggested does take place, it is the duty of every public organ to further the only remedy which strikes at the root of the trouble.

OVERSEAS OPENINGS FOR BRITISH TRADERS.

Alertness in Advertising.

The Board of Trade, in a memorandum dealing with the subject of motor vehicles and components, point out that the amount of business which might be diverted to British manufacturers is as follows, the sums being for complete vehicles and also for engines and other parts: In the United Kingdom, £467,000, and in colonial and neutral markets, £3,072,000. The prospects for British motors in colonial markets and in those of other countries are referred to in consular reports, from which the pamphlet gives extracts.

Referring to the South African demand for a low price car, the report says:—"German firms were keen to perceive, and to profit by, the opportunities afforded by motor shows. Also they made free use of advertising media, liberally assisting their representatives who sought to participate in any promising advertising scheme. This raises a rather live question—the value of publicity and the practice of giving material assistance to those agents who believe in it but cannot, unaided, give effect to their ideas. Business firms nowadays cannot afford to be altruistic, and they are not likely to evince any undue haste to assist an agent financially, merely to oblige him; still, if they themselves are convinced of the gain to be derived from advertising, it is simply a matter of good business policy to help the agent and not leave him to take all the risk."

We ourselves can bear testimony to the readiness of German manufacturers to secure the advantages offered by advertising in Great Britain.

In urging the need for immediate action the pamphlet says:—"Organised effort will secure for us a larger measure of the world's trade than hitherto. The points wherein the Germans have previously scored are the following: Attention to detail and the special requirements and tastes of customers; superior salesmanship; skilful organisation of industries as a whole; financial backing of industrial undertakings by the banks; organisation of an efficient consular service; State support of industrial enterprise; superior technical training of employees and officials; encouragement of research; and application of science to industry. All these weapons are quite within the reach of our people; they have only to be taken in hand and utilised in a serious systematic manner and without delay."

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OMNIBUSES AND ROAD TOLLS.

(CONTRIBUTED.)

A plea for ratepayers' relief in respect of the cost of repair of roads damaged by motor omnibuses, and similar obligations for the latter as for tramways.

In quite recent years the Legislature, on the demands of the road authorities concerned, has imposed upon various municipal and company tramways the obligation of making some contribution towards the maintenance of the roads over which it was proposed to run railless trolley cars or motor omnibuses. Such contribution was deemed necessary consequent upon the excessive wear which is undoubtedly occasioned by the use of such vehicles. Except in two cases mentioned later on the obligations governing the foregoing provisos relate to the operation of the vehicles named in districts outside the metropolitan and adjacent areas. Many cases still exist, however, where tramway companies and others operate motor omnibuses in which the proprietors have so far escaped the obligations mentioned.

In arriving at a decision requiring a contribution towards the maintenance of the roads, no doubt the Select Committees before whom the respective Bills came, considered on the one hand, the benefit and convenience to the travelling public accruing from the institution of the proposed services. On the other hand, they no doubt considered the increasing burdens that must fall on the ratepayer if the roads are to be maintained in a satisfactory condition to carry the traffic, and also the convenience and safety of all other kinds of traffic having a right to use the roads.

Within the past few years there has been a tendency on the part of those operating motor omnibuses to establish, at a very considerable expense to the ratepayers, a right of user of the roads in a manner and to an extent not previously anticipated, and with little, or, indeed, in some quarters, any regard to the increased expenditure thrown on the public purse by the breaking up of roads by their traffic upon them, which would otherwise be satisfactory.

It should be borne in mind that the increasing burden on the ratepayers for the maintenance of roads is very largely caused by the traffic mentioned passing from one borough or district to another that bears no share of the rates, and it cannot be expected that such conditions will be allowed to continue indefinitely.

From reports that have been made by road surveyors throughout the country generally, it would appear that motor omnibuses running frequently upon a definite route, and picking up passengers by the way, do very considerably more harm to the roads—no matter how they are constructed—than do other vehicles which, though carrying heavier weights, run less regularly and at a less speed. It has been stated in evidence before a Select Committee of the House of Commons—in regard to an application for Parliamentary powers to operate motor omnibuses—that a loaded motor omnibus weighed nearly six tons. A peculiar circumstance in connection with this weight is that four tons are on the rear axle and two tons on the front axle, the result consequently being that there is a considerable "knocking" action, which damages the roads far more than any other kind of action. A heavy traction engine, even if it goes once a day each way, is nothing compared with this continual "knocking" action of motor omnibuses in the case, say, of even a quarter-hour service from 8 a.m. till 9 or 10 p.m.

"The increasing burdens that must fall on the ratepayer." Surely in this expression is contained the very essence of the whole matter so far as requiring an obligation on the part of operators to contribute is concerned.

That very serious damage to roads arising out of the traffic mentioned largely occurs in the metropolitan and other areas, and is occasioned, as previously mentioned, by reason of the frequency of the numerous services operated, is beyond doubt.

Mr. H. T. Wakelam, the engineer to the Middlesex County Council, in a paper which he read at the annual meeting of the Institute of Municipal and County Engineers in July, 1913, referred to the considerable damage which had been occasioned to ten or more roads in the Council's area during the three previous years. Mr. Wakelam stated:—

> The average cost per yard, super, for the three years previous to motor omnibus traffic, had been 6·1639d., whilst on the same ten roads, for 1912–13, the cost has been 12·8005d., being equal to an increase of 107 per cent. He found that the charge for maintaining the road during 1912–13, which in 1911 carried ordinary weights, was ·609d. per ton per mile, on the total vehicular tonnage which passed over it during the year, amounted to ·914d. *more per ton per mile*, nearly 1d., and, in his opinion, the increase *was wholly due* to the fact that the road in 1912–13 *became a motor omnibus road*. The increased road upkeep works out at 2d. per car per mile, or a little under ·305d. per ton per mile.

Mr. Wakelam expressed the view that the amount of license per vehicle paid by the omnibus companies was in no way equivalent to the damage the omnibuses caused, and that legislation was needed in this connection, and also in the direction of empowering road authorities to direct which roads shall or shall not be subjected to a continuous use by motor omnibuses. He also said:—"It would be well if motor omnibus traffic could be governed by general regulations issued by the road authority concerned."

By the courtesy of a surveyor to a large district in the metropolitan area served by motor omnibuses, the writer has been favoured with two photographs, and both are reproduced herewith.

Illustration No. 1 shows the apparent excellent condition of the road before the service commenced, and which would have withstood ordinary vehicular traffic conditions for some years.

Illustration No. 2—and it is a typical instance of many other roads which have become in a similar condition as the result of motor omnibus traffic—shows the state of the road *less* than a year after the service began.

The subsequent condition of the road was, of course, such that the authority concerned were compelled to incur a very great expense in repairing and putting it again in a good state. As the law now stands the ratepayers have to "foot the bill" for such quite unnecessary expenditure, and they have no redress against the owners of the vehicles that destroy their roads at will. It is too evident that road authorities and ratepayers are now heavily punished by a form of traffic from which they receive no revenue, and over which they have no control. From every conceivable point of view they are entitled to adequate payments towards the cost of maintaining the roads over which the motor omnibuses are run, and also to their control.

At a conference of Local Authorities held in London, October, 1912, the following resolution, among others, was passed:—

> "That, in the opinion of this Conference the Motor Omnibus Companies should be compelled to pay an equitable contribution towards road maintenance in the districts over which they travel."

In evidence before the Select Committee on Motor Traffic (May, 1913), it was stated that, if the London motor omnibus proprietors had to pay a contribution towards track and road improvements, and rating on the track, equivalent to what the London County Council pay, of £200 per vehicle, it would amount to about £600,000 per annum.

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It was mentioned before the same Committee that in October, 1912, a conference, representing 33 Local Authorities in the metropolitan area, had passed the following resolution :—

> That this conference is of opinion that it is urgently necessary, having regard to the increased cost of road making, the risk of serious accidents, the detriment of property, and the loss and inconvenience to tradesmen and others arising from the use of motor omnibuses on highways in the districts surrounding the metropolis, which, in the judgment of the Board of Trade, Local Government Board, or other Government Authority, after consultation with the Local Authority, are unsuited for traffic of this discription, that requisite powers should be conferred upon the Board of Trade, Local Government Board, or other Government Authority, to limit and define the routes to be taken by such traffic.

Subsequently 23 other local authorities within the same area passed a resolution to exactly the same effect.

Before Use by Motor Omnibuses.

Still later, what is probably one of the most influential conferences ever held in connection with local government in London, of 104 authorities, including the County Councils of Essex, London, and Hertfordshire, Middlesex and Surrey, passed a similar resolution as to the damage caused to the road surfaces by motor omnibus traffic. It will be apparent from the foregoing how serious a view is taken by the authorities mentioned in regard to the damage occasioned to the roads in their respective areas from the motor omnibus traffic, and, also, the expenditure that the ratepayers are called upon to provide as a result of such damage.

One of the two exceptions to which reference was made where a payment in respect of road maintenance has been required—in the metropolitan area—refers to the Metropolitan Electric Tramways Company, who, in 1913, obtained powers to work a railless trolley route in Tottenham. Under the Act mentioned, "the company are required to pay any extra expense incurred by the road authority in repairing and maintaining the road upon which the trolley vehicles may be run."

So far, the company have not yet constructed the system authorised, and one wonders whether the reason therefor is to be found in the fact that, since the powers were obtained, the company have become closely allied with the London Traffic Combine, and do not wish to put into recognition a principle which, sooner or later, will, doubtless, become a general one, so far as motor omnibuses are concerned.

The second instance in the metropolitan area, where powers requiring a contribution to road maintenance from motor omnibus operators were applied for and granted, was in the case of the Middlesex County Council in connection with the Council's Western Road and Improvements (and Finance) Bill, in the Parliamentary Session of 1914. The Council asked that some provision should be inserted in the Bill by which omnibus companies should be made to contribute towards the maintenance of the road. When the Bill came before the Select Committee it was stated by Mr. H. T. Wakelam, the engineer to Middlesex County Council, that many of the roads in the Council's area had been enormously damaged as the result of motor omnibus traffic, and that the cost had already run into hundreds of thousands of pounds. The witness gave specific details of the cost incurred in making good a number of roads following the advent of motor omnibus traffic.

Mr. Balfour Browne, K.C. (who was counsel for the Federation of Motor Omnibus Proprietors, and who opposed the proviso asked for), cross-examined Mr. Wakelam, as follows :—

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Am I not doing a great service to the public by running 'buses ?—And so are tramways, which have to pay for the maintenance of the roads, doing quite as much service, and they have to pay rates and maintenance of the road as well. They are running side by side with the motor omnibuses who pay nothing at all.

Are you aware that the motor omnibuses in London have done huge harm to the tramways owned by the London County Council ?—Yes ; they have to our system as well.

(NOTE.—The Middlesex County Council Tramways are worked under lease by the Metropolitan Electric Tramways.)

Is it not why you hate them, but why you want to tax them ?—No, we only want what is fair to the ratepayers generally. It is not fair for a County Council to see one company working for a profit paying rates on their undertaking, and another company running side by side to their detriment not paying anything at all for road usage.

Do you know that all over the country that traffic on main roads has enormously increased ?—That may be so, but along the particular road I mentioned, where we took the extra-ordinary damage the motor 'buses did to the road, there was very little increase in the ordinary traffic, if any.

The Same Street after Less than a Year of Omnibus Traffic.

The engineer and surveyor to the Metropolitan Borough of Hackney, who also gave evidence in connection with the Bill referred to, stated that :—

> Subsequent to the motor omnibus traffic passing over the various roads and streets in the borough of Hackney, the charges for road maintenance had increased very considerably. Whilst agreeing with the learned counsel (Mr. Balfour Browne, K.C.), in cross-examination, that "the 'buses were serving the public," he stated that "at the same time they were injuring the public," by reason of the "increased road charges which were consequently thrust upon them."

The Select Committee of the House of Commons, before whom the Bill came, decided that the company, i.e., any authority, company or person working or running any service of mechanically-propelled omnibuses on any part of the new roadway, Work, No. 1, by this Act authorised :—

> Shall pay to the Council a sum equal to three-eights of a penny per car mile by any such omnibus over the new roadway, Work No. 1, by this Act authorised, towards the cost of maintenance of such roadway.

In arriving at the foregoing decision, the Select Committee were, no doubt, influenced by the fact that Parliament had already laid down the principle in previous sessions that railless trolley cars and motor 'buses, operated by various local authorities and companies (in respect of which Parliamentary powers had been obtained) should directly contribute to the repair of the wear and tear of the roads proposed to be run over.

When the Bill came before the House of Lords for final discussion, on Monday, July 20, 1914, the Duke of Bedford, who urged the retention of the clause in regard to the payment of three-eighths of a penny per car-mile, in respect of motor 'bus operation over the new Western Road, and Lord Montague of Beaulieu, who opposed the proviso, spoke as follows :—

The DUKE OF BEDFORD :—

> Your Lordships know the enormous damage done by the motor omnibuses to the country roads all over England. These vehicles have got on the roads under conditions extremely favourable to themselves. In the case of a tramways undertaking, the promoters have to come to Parliament, and Parliament imposes conditions upon the tramways for the upkeep of the roads. It is not so with the motor omnibuses. All the owners have to do is to obtain a license, and having got a license, they can establish a line of omnibuses on any of the roads as much as they like, without anybody's leave ; they may damage the roads as much as they like and you cannot get anything out of them. We had it in evidence before the

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Committee that, at the annual meeting of the Urban District Councils held last year, at which 200 Councils were represented and 400 delegates were present, the following resolution was passed :—

> That this conference is of opinion that local authorities should have the power of laying down defined roads for omnibus traffic, and such traffic should contribute towards the cost of road maintenance, in addition to the petrol tax at present levied.

The noble Earl of the Cross Benches (Lord Meath) is quite right when he says that motor omnibuses carry a large number of persons belonging to the class of the community which cannot afford any other form of motor carriage. But, of course, the motor omnibus is not a benevolent institution upon wheels run for philanthropic purposes. All these motor omnibuses are the property of companies, trading for profit, and if you put a charge upon them for the damage they do to the roads, you diminish the profits, and that explains the opposition of the motor omnibuses to the clause. The noble Lord who moved the amendment (Lord Montagu of Beaulieu) asked why motor omnibuses should be taxed and not heavy mechanically-propelled vehicles. The reason is that the traffic of motor omnibuses is *continuous* ; they pass to and fro frequently. The noble Lord said that he could produce evidence that in Westminster and Piccadilly motor omnibuses did not do much harm to roads. When the traffic is congested motor omnibuses have to go slowly and do less damage to the roads, but on open roads they go swinging along at a rapid pace and do more harm. I do not know whether the noble Lord objects to the principle of taxing motor omnibuses for the repair of the roads.

LORD MONTAGU OF BEAULIEU replied that :—

> He was in favour of some scheme whereby the taxation of heavy vehicles became a general principle, but that he was not in favour of dealing with the question in a piece-meal fashion.

The DUKE OF BEDFORD :—

> I understand that the noble Lord does not object to the principle of taxing motor omnibuses, but thinks that this is the wrong time to begin, on account of anticipated legislation which is to proceed from the intention to appoint a committee to inquire into the matter. I do not know whether the noble Lord can say when we shall get this legislation. It may be three or four years before anything is done. Are we to make no attempt in the meantime to put some charge on motor omnibuses ?

In the end, the House of Lords finally approved of the proviso. The principle in regard to a road maintenance contribution having thus been specifically established in the metropolitan area, where so much damage is caused by motor omnibus traffic, it is apparently essential, in order to afford the relief to which the road authorities and ratepayers are entitled, that a proviso of the character indicated should be brought into general effect. It is more than unfair in every respect that the legislature should continue to permit what would appear to be the subsidising of motor omnibus operators by the ratepayers to the extent of about £600,000 a year ! Those who use the public thoroughfares for profit at the expense of the ratepayers should be compelled to make a substantial contribution towards the maintenance of the roads used, and thus should be terminated what has too long been tolerated—the existing unjust conditions.

As is well known, tramcars are only permitted to run on routes sanctioned by Parliament. On the other hand, motor omnibuses are free to go anywhere at their option. In the words of the Duke of Bedford, all the owners have to do " is to get a license, and, having got a license, they can establish a line of omnibuses on any of the roads as much as they like, without anybody's leave ; they may damage the roads as much as they like, and on the open roads they go swinging along at a rapid pace and do harm."

In respect of tramways, the track is provided and maintained by the owners. In the metropolitan area thousands of pounds have been expended on road widenings and improvements to afford facilities in working. That tramways contribute largely to the maintenance of the roads used is beyond question. From the last issued Board of Trade return, and other records available, it would appear that the tramways undertakings—in the case of companies for the year ended December 31, 1913, and in respect of the municipal systems for the year ended March 31, 1914—expended the sum of £289,051 on their track repairs. It may very well be assumed therefore that the various road authorities through whose districts the tramways operate effected a saving of at least the amount mentioned by the several systems maintaining the greater portion of the roadway.

Whilst, however, expenditure of the character indicated is an obligation which Parliament has imposed upon the tramways, yet, under the altered conditions of working from horse to electric car, no wear can be caused to the paved surface of the streets by the passing of vehicles which are confined to rails.

The damage to street paving caused by the motor omnibus traffic is extremely large, and of a general character, affecting practically the whole road surface. The section of the road upon which tramways are constructed and maintained by them are a great benefit to the general vehicular traffic, since such portions of the street are as a rule well maintained by them and largely used by vehicles—and therefore most rapidly worn out—to be again repaired by them.

What a contrast the payment made by the tramways is when no similar payment is required, as, for instance, in respect of the damage to the roads occasioned by the motor omnibus traffic in the area of the Middlesex County Council, which damage, as Mr. Wakelam said, " had already run into hundreds of thousands of pounds ! " The track, or roads, used by the motor omnibuses is provided and maintained by the rates, and the repairs to the same are paid for by the general ratepayers. Tramways also are under statutory obligations to provide exceptionally cheap fares for workpeople's services. The motor omnibuses are under no obligations to give similar facilities ; indeed, as a rule, they only begin to start after the workpeople's tariff has ceased.

The tramways also pay rates on their tracks. Except in the case of the London County Council, the other systems do not show separately in their accounts the amounts paid in respect of rates on track. For the financial year ended March 31, 1915, the undertaking named paid sums amounting to £87,827 18s. 11d. to the local authorities. The motor omnibus operators make no similar payment. It will be apparent therefore that the omnibuses are permitted to operate under conditions of " unmatched freedom from every point of view."

Under the present law the tramway is the only method of traction held responsible for road construction and maintenance, which weights it with a heavy disadvantage in comparison with its competitors.

Motor omnibuses should be placed under obligations similar to tramways. They should operate under properly defined franchises, and, in addition, pay towards road maintenance in proportion to the burdens they impose upon the ratepayers by their service. Whilst tramways have no legal right to expect perpetual freedom from competition, they have every right, by reason of the conditions which Parliament has imposed upon them for the upkeep of the roads—together with the taxes which they pay on their tracks—to expect freedom from practically unregulated and untaxed services of the character being carried on by the motor omnibuses. What possible objection can be urged to requiring motor omnibuses to follow a like procedure ? Twenty-one million pounds of tramway expenditure in the metropolitan area should not be jeopardised by the unfair conditions now existing.

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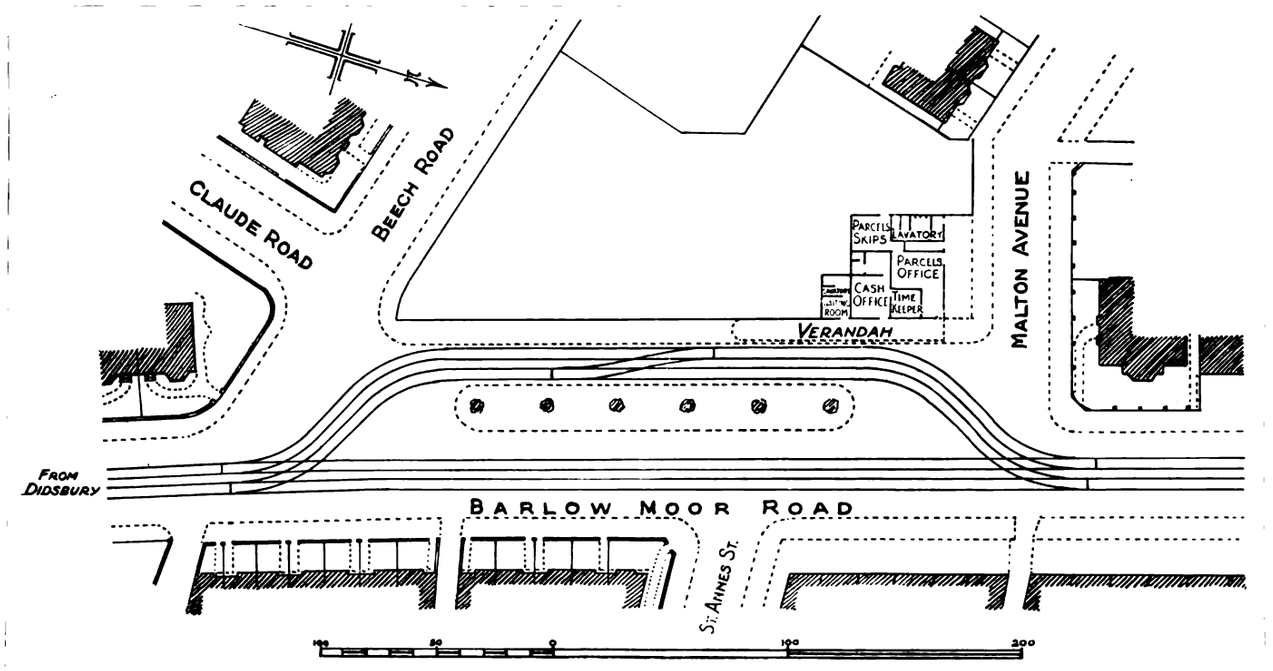
A SIDING TO OBVIATE A DEAD END.

A MANCHESTER SUBURBAN TRAMWAY IMPROVEMENT.

The Chorlton-cum-Hardy district of the city of Manchester has developed rapidly during the past few years, causing a great increase in the number of tramway passengers. The terminus of the route being on the main road made it a source of danger to passengers boarding or leaving the cars, and the Tramways Committee, on the advice of the general manager, Mr. J. M. McElroy, decided to purchase an adjacent plot of land for the purpose of constructing a siding and tramway offices. The plan shows the siding, which was constructed by the department's staff, and the ground plan of the offices. The track is constructed with B.S.S. No. 4 rails on a stringer of concrete, the joints being fished together. The footpaths have been laid with concrete flags, the roadway with granited rock asphalte.

The building, which was erected to the designs of Mr. Henry Mattinson, A.M.I.C.E., chief civil engineer of the Tramways Department, is of half timber framing with rustic brick plinth and tiled roof. The basement comprises a mess-room and lavatories for the men, and a heating chamber with low pressure hot water apparatus. On the ground floor are situate the parcels office, skip room, and cash office. There have also been provided conveniencies for gentlemen and a ladies' waiting room with conveniencies attached. Along the front a glass-covered verandah to provide shelter for passengers has been erected. As the accompanying photograph shows, the building has a pleasing appearance. The contractors for the building were Messrs. C. H. Normanton and Son, Ltd., of Manchester.



Plan of Tramway Siding and Shelter, Manchester.

New Terminal Shelter and Offices—Manchester Tramways.

Petrograd Trams May Stop for Fuel.—The Petrograd Town Tramways Board has reduced the number of cars circulating on the town tramways system because of the scarcity of fuel and the need to economise petroleum, with which the boilers of the town electric station are fuelled. The stocks of petroleum are running down, and no more is coming to hand. Efforts to enlist the support of the Ministry of Ways of Communication have failed of success, and it is feared the whole tramway system of Petrograd must come to a stop. The Town Council, says the *Nowoje Wrèmja*, is entirely to blame for the trouble. It might have had the required petroleum brought along by motor, and have laid in the necessary stocks of liquid fuel in the summer time. Now the population will have to suffer for its neglect.

Gateshead and District Tramways Company propose to seek powers to double the tramway lines in the Felling district, widen portions of the road, and make other alterations in connection therewith.

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WOMEN CONDUCTORS IN LONDON.

With a view to removing obstacles to the enlistment of men employed as conductors of stage carriages the Commissioner of Police for the Metropolis on October 20 withdrew his opposition to the employment of women as conductors. Before this announcement was made the Commissioner held conferences with the managers of tramway and omnibuses undertakings. Representations on the matter had been made to the Home Secretary as the result of annual conference of the Municipal Tramways Association.

The Commissioner of Police has issued instructions that in the event of managers of tramways undertakings furnishing certificates to women for the purpose of obtaining licenses to act as conductors of metropolitan stage carriages, such certificates should show that he has satisfied himself in the following particulars :—

(a) She is sober, honest, and of good character.
(b) She is physically fit to perform the duties.
(c) That her name and age are correct as shown by certificates.
(d) That she is of British nationality, and the same has not been forfeited by marriage.

If the foregoing particulars are clearly shown, it will materially expedite the issue of the license. It is stated that, as with male employees, the police are enforcing the regulation requiring an applicant to be photographed at Scotland Yard.

Of the London omnibus companies, Thomas Tilling, Limited, are the first to employ women. On November 2 a woman conductor appeared on the Peckham-Isleworth route. For a start the company intend to employ fifty women, their ages to be betweeen 21 and 40. They will be paid at the same rate as men, from 6s. to 8s. a day, and will work 10 hours. The uniform comprises a grey melton cloth skirt and three-quarter length coat, with red piping, leather cuffs and collar. The edge of the skirt is bound in leather. A peak cap with a pliable band will be worn. The accommodation, provided under the direction of the wife of an official of the company, includes sleeping facilities in the event of an omnibus breaking down.

Among the London tramways undertakings, the London United Company are likely to be the first to place women on the conductor's platform. One hundred and fifty are to be trained with all despatch, and in a short time the company hope to be able to increase the service of cars. The age limits are 25 to 35 years, and the pay will vary from 25s. to 30s. a week. The uniform is of dark blue cloth, with waterproof hat and coat for wet weather. Gaiters are contemplated in order to prevent coldness of the feet. At some depots new waiting mess-rooms are being erected, and elsewhere private premises are being rented.

Ilford Council have decided to utilise the services of women as conductors at the same rate of pay as men. As a beginning twelve have been instructed, and it is hoped that they will be able to take their places on the cars before the end of November.

At the meeting of London County Council on November 8, the Highways Committee recommended that women employed during the war, and so long as conditions are abnormal, should be paid proportionately to the time worked, at a rate equivalent to the present minimum daily rate of pay of male conductors (5s. a day), with the usual increments according to length of service, in addition to the war grant of 6d. a day, or 3s. a week.

CAR DRIVING BY WOMEN.

An experiment is being made at Glasgow in the use of women as tramcar drivers. On November 1 the department began training a number of women conductors who had volunteered their services for the purpose of the test, which had been decided upon in view of the likelihood of a considerable number of motormen answering to the new call to the colours. The test of the women's capability to stand the strain upon the physique and nerves entailed by car driving is likely to be an exhaustive one. Upon the result will depend whether the management will advise the Tramways Committee to proceed further with such a method of maintaining the tramway services during the period of the war.

Judging by the experience of German tramway undertakings, the employment of women as car drivers is not altogether a success. In August last the military authorities informed the Berlin Tramways Company that all the motormen would be required for army service in a short time, and the management set to work to instruct 250 women in car driving. According to a report from Berne on October 31, this expedient has not shown the suitability of women for the work in any German town where it has been tried, and the positions of motormen are being filled as largely as possible by men from neutral countries. On October 31 a Swiss newspaper contained an advertisement for 60 trained tramwaymen for the Berlin service, which is a proof that every able-bodied man in the employ of the company is being called up. For some months now women have predominated among the conductors on German tramway undertakings.

EXAMPLES OF "OSRAM" STRENGTH.

The accompanying illustration, reproduced from an untouched photograph, is an example of "Osram" strength. The photograph was sent to the General Electric Company by a correspondent, who wrote in his covering letter :—"Enclosed is a photo. which I took in the waiting-room at the Mond Nickel Institute, Clydach-on-Tawe. The wire (flexible cord) of the lamp broke, and the lamp and shade fell a distance of 4 ft. on to the wooden table. The shade was smashed to pieces, but the lamp stuck upright in the table, and neither the globe nor the filament was broken ; when the photograph was taken it was lighted on another connection."

We have received from the General Electric Company a communication (passed by the Censor) enclosing a copy of a letter forwarded to the Osram-Robertson Lamp Works, Hammersmith,

London, W., in which the following passage occurs :—"On the night of —— my house was struck by a bomb, and so far wrecked as to render it unsafe to dwell in. Two years ago I had the place fitted with electric light, when a dozen of your 32-candle-power metal filament lamps were put in, and had been in use constantly up to the time of the raid. After the house had been struck, and in the course of the removal of the furniture on the following day, we found every lamp sound, and they have been removed from the fittings and stowed away with the furniture."

An electrician who visited the house in order to report on electrical damage, informs the General Electric Company that he "found windows and doors demolished, an iron safe, weighing many hundredweights, wrenched out of position, ceiling down and joists hanging, and brickwork badly damaged. But the Osram lamps, living up to their high reputation, had survived the shock, and were intact, even though the opal shades were smashed to fragments."

Departmental Committee on Heavy Traffic.—The sittings of the Local Government Board Committee on Heavy Traffic are being continued. During the last week in October the Commercial Motor Users' Association put forward their evidence and suggestions. At the annual meeting of the Institution of Municipal and County Engineers, a letter was received from the Municipal Tramways Association offering assistance in the preparation of evidence to be given before the Departmental Committee on Heavy Traffic, but it was decided to reply that the evidence of the Institution had already been tendered, and that the Council were not prepared to take further action.

Russian Railway Cars on Tramway Routes.—The *Nowoje Wrèmja* says that last month (October) experiments were, made in the use of the Petrograd tramway lines for drawing railway trucks by tramway motor cars along the street railway lines to hasten and cheapen the removal of the great stocks of goods that have accumulated at the town railway stations. It appears that the ordinary goods wagons proved to be awkward to move about, but some less cumbersome wagons were moved with great success. The railway board proposes to alter and equip suitably about 200 railway wagons for "town" service.

Tramway Projects in Russia.—It is stated in a Petrograd newspaper that tramway construction is contemplated at the following places :—Baku, Voronezh, Lugansk, Kutais, Omsk, Orenburg, Pensa, Plotava, Samarkand, Tamboff, Tomsk, Uman, and Yalta, and that it is proposed to extend the tramway systems at Vladivostock, Odessa, and Rostoff on the Don. A movement is on foot at Smolensk and Tiflis to buy up the private tramway companies on behalf of the respective municipalities. With the coming building season, says the *Nowoje Wrèmja*, the Petrograd Council will proceed to complete a series of tramway lines that were left unfinished last year. The work will, it is intended, be completed by October next.

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YEAR'S ACCIDENTS IN LONDON.

A Home Office return relating to accidents in the Metropolitan police district during the year 1914 discloses so great an increase as to call for consideration of the advisability of united action on the part of the police, traffic undertakings, and local authorities in educating the public to a better appreciation of the dangers of the streets. The expenditure would be fully justified by the saving of life and the prevention of suffering, to say nothing of the reduction of compensation paid for accidents by tramway and omnibus undertakings, and by owners of private vehicles. That the darkened streets are mainly the cause of an increase of fatalities by 58, and of non-fatal mishaps by 6,295, cannot be denied.

The total deaths numbered 637 Of these, 126 were caused by horse-drawn vehicles, 18 by pedal bicycles, and 493 by mechanically-propelled conveyances. The statement that among the latter were 148 deaths due to motor omnibuses, or 40 more than half of the total, must give rise to anxiety on the part of those responsible for the proper running of these vehicles. This, too, is for a period when the number of omnibuses had been reduced by impressment for war purposes. It must be remembered also that private motor conveyances largely outnumber the omnibuses. The reduction in the number of omnibuses, combined with restricted lighting, no doubt partly accounts for non-fatal accidents due to tramcars outnumbering those caused by omnibuses, the totals being 3,171 for the former, and 3,007 for the latter. Other mechanically-propelled vehicles caused 8,460 accidents, pedal cycles 5,578, and horses 5,023.

In the City of London there were 19 fatalities, as compared with 17 the previous year, and 1,253 non-fatal, as against 1,210 in the preceding year. To render the returns complete the figures should indicate the number of accidents occurring after sunset, and those occasioned by motor vehicles at tramway stopping-places.

Dr. Waldo, the City Coroner, in commenting on the figures for the City, attributes the comparative fewness of traffic accidents to the excellence of the City police, the thorough and prompt manner in which means are taken for preventing accidents, and the superior legal powers in regard to traffic which the City possesses. He urges, however, that there should be more street refuges, more police at traffic points, and more life-guards or fenders for heavy motors.

During the past six months the dangers of the London streets have been increased by the Army authorities permitting lorries containing A.S.C. driver recruits being driven through the busiest thoroughfares in order to accustom the men to driving in traffic. One of the vehicles recently mounted the pavement at the corner of Victoria Street and Vauxhall Bridge Road, crushing a pedestrian. At the inquest an instructor stated that the recruits received three or four days' training in the country, and were afterwards taught to drive in London. The jury expressed their opinion that the period of training away from London should be of longer duration, and that the instructor should have independent control of the vehicle.

ACCIDENT AT DEWSBURY.

A tramcar overran the terminus in Dewsbury Market Place on October 12, owing to the trolley-pole leaving the wire in the middle of the down gradient, and ran a distance of 30 yards into a boot

shop. An hour or so later the three-storied building collapsed on top of the car. Several persons were injured, the most serious cases being the motorman and the woman conductor, who sustained concussion of the brain.

Argentine Railway Extension.—It is reported that a new 71-mile railroad is to be constructed between Alvear to San Rafael, Argentina. The region traversed is said to be well irrigated and under intense cultivation. The system adopted is that of the so-called secondary railway with a 2·46 ft. gauge. Steam traction will be used at first, but it is planned to electrify later. Work will be commenced in about six months.

LIVERPOOL CORPORATION TRAMWAYS.

RECORD TRAFFIC—WAR TIME ECONOMY.

A report presented to Liverpool Tramways Committee on October 8 by Mr. C. W. Mallins, general manager, says :—The first nine months of the present year have proved a record over all previous years, as regards the total receipts and the number of passengers, also the car mile earnings, as shown by the following statement, viz. :—

	1915.	1914.	Increase.	Decrease.
Receipts	£521,546	£517,240	£4,306	—
Passengers	112,918,654	109,902,170	3,016,484	—
Mileage	9,557,276	10,455,543	—	898,267
Earnings per Car Mile ...	1s. 1·10d.	11·87d.	1·23d.	—

The following are the principal matters dealt with by the committee during the nine months, viz :—

In connection with the grants under the resolution of the City Council of September 21, 1914, of the difference in wages between army allowance and standard rate of pay to employees who have been mobilised for His Majesty's services. the amount payable by the Tramways Department is about £500 per week, or approximately £26,000 per annum.

In connection with the resolution of the Special Committee appointed by the City Council of March 10, the amount paid to the various employees receiving wages or salary up to £3 per week from March 1 to date, is £8,100.

The committee on July 16 approved the report of the general manager, requesting authority to employ a number of women as car cleaners in the Sheds Department, thereby liberating a number of men who, from age or other reasons, are not eligible for H.M. service, but would be capable of acting as temporary conductors pending the return of the regular men after the war. The women have performed their duties satisfactorily, which include the cleaning of the inside floor, staircases, seats, windows and platforms on both the lower and upper decks.

The illuminated and decorated car has from time to time been exhibited for the purpose of stimulating recruiting and also for the collection of funds in aid of the various charities in connection with the war.

The following free passes have been issued, viz :—

Soldiers and sailors	5,230,780	@ 1·127d.	= £24,562	17 5
Officers	120,914	@ ,,	= 567	15 10
Wounded soldiers...	30,863	@ ,,	= 144	18 7
Nurses	24,397	@ ,,	= 114	11 3
	5,406,954		£25,390	3 1

The staff of about 400 men at the works has been considerably depleted, owing to army mobilisation, and this reduced staff has been employed throughout the year in the general maintenance of rolling stock, which has been kept in a satisfactory condition by special effort. A large number of cars have been overhauled, as usual, and painting and varnishing have been carried out as far as possible.

The installation of the first 100 new motor equipments has been completed, but, owing to war conditions, the contractors have up to the present been unable to make any further delivery under the contract for these equipments during the current year. The new car repair shop has been completed and in full operation for several months.

The whole of the energies of the reduced staff in the Overhead Equipment Department have been devoted to maintaining the lines in good condition, and this has been satisfactorily achieved. About 12 miles of trolley wire have been renewed as required.

Owing to war conditions, the general manager, in accordance with the resolution of the City Council of April 7 last, has deferred expenditure on the following items during the year, viz. :—

Additional rolling stock	£13,000
Alteration to works	6,000
New machinery	1,000
Alterations to and replacement of cars	23,000
Bowring Park car shed	7,000
	£50,000

Other economies have also been effected in various departments, amounting to the present to about £17,000, or a total of £67,000. About 230 men are engaged in shell making, and it is hoped that this number will be largely augmented.

Mr. E. Russell Taylor, chairman of the Tramways Committee observed that the nine months' working had been satisfactory in every way. The manager had had to contend with many inexperienced men among the employees, but owing to his forethought the inconveniencies of a reduced general service had been minimised.

During the first week in November the Tramways Committee agreed to employ women as conductors.

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DICK, KERR AND COMPANY.

INCREASED PROFITS.

The report of the directors for the year ended June 30, 1915, shows that the profit earned amounted to £46,959. Including the amount brought forward, there was an available balance of £72,485. Out of this sum the debenture interest and trustee fees had been paid, and £10,838 had been reserved to provide for the premiums payable on the redemption of the present debenture stock, leaving a balance of £61,646, which had been appropriated as follows: -Dividend of 6 per cent. on the preference share capital, £18,300; reserve against contingencies, £25,000; balance forward, £18,346. In view of the abnormal conditions prevailing the directors were unable to recommend the payment of a dividend on the ordinary shares. A comparison of the results for the past four years is appended:

Year Ended June.	1915.	1914.	1913.	1912.
	£	£	£	£
Net profits	46,959	44,761	30,092	3,275
Balance from last year	25,526	10,325	10,016	36,892
	£72,485	£55,086	£40,108	£40,167
	£	£	£	£
Debenture interest and trustees' fees ...	10,538	10,961	11,183	11,551
Reserve for prem. on deb. stock redeemed ...	300	300	300	300
Year's dividend on 6 per cent. pref. shares ...	18,300	18,300	18,300	18,300
Reserve against contingencies	25,000	—	—	—
Balance	18,346	25,525	10,325	10,016

Mr. Claud T. Cayley presided at the annual meeting of the company on October 21. In moving the adoption of the report, he stated that he had no reason for altering his opinion that they would experience some lean years after the war before they could hope for the re-establishment of their standard business, especially in heavy manufacturing. The profit in the past year was principally derived from orders and contracts taken before the war. These were not being replaced by others of similar nature, so that, although they were busy now on abnormal work, there was bound to be a transition period, occupied in re-establishing normal conditions, and it was because of this that the directors could not see their way to recommend a dividend on the ordinary shares. They felt that some reserve must be made to bridge over that period. Although the directors were primarily pleased, because they believed they, as a company, were assisting the Government to a material extent, they were also hopeful that some reasonable profit proportionate to the efforts being made would be permitted—sufficient, at all events, to make it unnecessary next year to put such a large percentage of profit to reserve for contingencies. Clear indications, however, had been given, first in the Munitions Act, and, secondly, in the Budget, of the Government's intention to absorb excess profits, especially if derived from work due directly to the war. No person could object to this principle, but at the same time no one —at all events outside of the Government —could predict to what extent it would be applied, and it therefore behoved them to be ultra-conservative in dealing with the accounts at the present time. There was no abnormal change to draw attention to in the accounts. Contracts were larger than they had been for some years. One cause was found in the Metropolitan Water Board contract, where a very large amount of plant was required, which was going on, although suffering to some extent for want of labour. Another cause was in connection with certain changes and developments on the manufacturing side of the business, respecting which, however, he could not go into details. The balance sheet was made up to June 30, 1915, and during the period covered by that document they were not as heavily engaged in the manufacture of war material as they were at the present time, and probably should be in the immediate future. Contracts figured at £460,365, which was larger than in many previous years. The capital position remained about the same, and they would notice that £25,000 had been placed to a special reserve for contingencies. He moved that the audited accounts, together with the report of the directors thereon, be adopted. Mr. R. H. Prestwich, deputy-chairman, seconded the motion, which was carried unanimously, and the payment of the dividend on the preference shares having been confirmed, the chairman proposed the re-election of the retiring directors. He remarked that it did not need any words from him to recommend the re-appointment of Mr. David C. Ellis and Mr. John Sampson. The motion was seconded by Mr. Prestwich and unanimously approved. Votes of thanks were accorded to the directors, and the management and the staff.

BOLCKOW, VAUGHAN AND "WAR PROFITS."

Sir J. E. Johnson-Ferguson, presiding at the fiftieth annual meeting held at Manchester, said the trading profit, after providing for depreciation, was very nearly 10 per cent. below the figure of the preceding year. They had come through a period of great anxiety. Nevertheless, he did not think the men employed in some of their collieries were doing what the country might fairly expect of them. Wages had advanced very considerably and the war bonus had seriously increased the cost of their productions. In the year ended June, 1913, nearly 50 per cent. of the price realised for their coal went in colliers' wages, but during the past year the wage-earners took over 63 per cent. These rising figures proved that, whatever advance had resulted in prices, no one had benefited so much as the wage earners. War profits only existed in the imagination of the ignorant, and he quoted the company's present reduction of profits compared with the three preceding years. He did not complain of the Government's limitation of the price of coal at the pit mouth so long as the various items of cost were kept at the same level. Otherwise the price-fixing Act was not only useless, but opened the door to litigation.

FINANCIAL REPORTS AND MEETINGS.

Indian Electric Supply and Traction Company announce an interim dividend of 2½ per cent.

Lisbon Electric Tramways Company.—An interim dividend of 2½ per cent., free of income tax.

Babcock and Wilcox, Limited, have declared an interim dividend of 6 per cent. on the ordinary shares, free of tax.

Calcutta Tramways Company are paying an interim dividend of 3 per cent. (3s. per share) on the ordinary shares.

Sao Paulo Tramway Light and Power Company.—The directors have declared a dividend of 2½ per cent. on the common stock.

Brisbane Electric Tramways Investment.—A dividend of 4s. per share, free of income tax, on the ordinary shares has been announced.

British Insulated and Helsby Cables.—An interim dividend of 5 per cent. actual on the ordinary shares on account of the current financial year has been paid.

Blackpool's Good Season.—As the result of the past season's trading, the decrease of £9,000 in the tramways receipts at the end of July has been converted into a surplus of £1,040.

Tucuman Tramways, Light and Power Company.—The accounts for the period from March 26, 1914, to June 30, 1915, after providing for interest on debenture stock, show a deficit of £42,517.

Callender's Cable and Construction Company.—The directors announce an interim dividend at the rate of 10 per cent. per annum (5s. per share) on the ordinary shares for the past half-year.

New St. Helens and District Tramways Company.—The directors announce a dividend of 2½ per cent. (2s. 6d. per share) on the preference shares, adding £5,000 to the reserve, and carrying forward £6,557.

Dartford Council Light Railways.—The accounts for the year 1914-15 show a balance on the revenue side of £862. The number of passengers was 1,623,070, the car-miles run 247,871, and the units of electricity used 271,090.

Brazilian Light, Power, and Traction Company.—A dividend of ½ per cent. on the ordinary issued capital stock will be paid for the past quarter. The dividend is in accordance with the arrangement announced by the board some time ago.

Dumbarton Burgh and County Tramways Company.—The accounts for the past year show a divisible balance of £10,790, after providing for debenture interest, and a dividend of 1½ per cent. is proposed on the ordinary shares, leaving £3,595 to be carried forward.

Chilian Electric Tramway and Light Company.—The net profits for 1914, after providing for debenture interest and redemption, were £106,086, and £9,438 was brought forward. £60,000 has been placed to renewals reserve, and £7,000 to insurance suspense account, leaving £48,524, which it is proposed to carry forward.

Norwich Electric Tramways.—The net profit for the year ended June 30 is £10,647, as against £11,076 for the preceding year. Including £797 brought forward, the amount to be dealt with is £11,444, which the directors recommend should be appropriated as follows: -£2,500 to reserve, £7,920 to payment of 3 per cent. dividend for one year, and £1,024 carried forward.

Hurst, Nelson and Company, Limited.—After providing for depreciation, etc., and including £16,811 brought forward, there is an available balance for the year ending July 17 of £68,390. After placing £13,694 to reserve to secure the preference dividend, and carrying £15,000 to general reserve, a dividend of 10 per cent. on the ordinary shares has been paid. A balance of £15,696 was carried forward.

Derby Corporation Tramways.—Alderman W. Hart, in introducing the motion for the half-yearly borough rate, stated that there was a profit of £1,500 on the electricity undertaking, which had been carried forward to next year's account. On the tramways undertaking there was a loss of £2,818, against a small profit in the previous year. The tramways renewal account now stood at £32,666, a very satisfactory figure.

Publication of London Returns Suspended.—The publication of the London County Council traffic returns has been suspended for the present. The last return issued was for the week ended September 22, for which week there was an increase of £4,984 over the

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corresponding week of last year. The result for the twenty-five weeks ended September 22 of the current financial year shows a net decrease of £4,285.

Southern Electric Tramways (Buenos Ayres).—The report of the Southern Electric Tramways Company (Buenos Ayres) for the year ended June shows a credit balance, after depreciating plant and machinery by 10 per cent., of $87,364, to which had to be added $23,293 brought forward. The sum of $1,747 is transferred to reserve, and $4,368 to contingency account, after which a dividend of 2 per cent. is declared and $20,565 carried forward.

Dundee and Broughty Ferry Tramways Company.—For the year ended July 31 the profit (including a sum brought forward), after providing for interest on debenture stock, amounts to £3,599. Interim dividend paid on preference shares absorbed £1,345, and the directors propose to pay final dividend on preference shares at the rate of 6 per cent. per annum for half-year ended July 1, less tax, to place to renewals fund £400, to sinking fund for redemption of debenture stock, £400, and to carry forward £110.

Dumbarton Tramways Company.—In moving the adoption of the report presented at the annual meeting, Mr. George Balfour (chairman) stated that while the total receipts (£23,340) had decreased by £259, traffic and power expenses had risen by £340, and general expenses by £44. Owing to the large expenditure made in 1913-14, maintenance expenses showed a reduction of £485. Dividends were declared at the rate of 6 per cent. on preference shares for the half-year, and at the rate of 1½ per cent. on ordinary shares for the year.

Wallasey Corporation Tramways.—The report for the year ended March 31 last shows a revenue of £63,690, as compared with £63,150. The expenses amounted to £42,454, against £40,490. Allowances to employees serving with the forces totalled £1,782, and war bonuses £75. The net revenue, including £1,136 brought forward, was £23,300, of which sum £8,000 has been credited to rate aid and £4,500 to reserve fund, while £11,225 has been applied to payment of interest on capital, sinking fund, and instalment on loans. Of the reserve fund of £46,135, the sum of £37,381 has been expended. The reserve fund (insurance) totals £1,859, and the sum applied in aid of rates in thirteen years £62,938.

Halifax Corporation Tramways.—The annual report shows an expenditure on capital account during the past year of £850, bringing the total now expended up to £418,701. The mortgage debt on the undertaking, after deducting loans repaid, stands at £283,249. The revenue for the year was £113,169, as against £109,650 in the previous year, and the net profit was £16,211, as compared with £13,643. The number of passengers carried was 20,707,071, as against 20,276,077. The receipts from parcels totalled £2,164, as against £2,147. Transfer tickets, which meet the requirements of passengers travelling short distances, and permit two short journeys being made at a cost of 1d., brought in £4,367, an increase of £724.

Manchester's Increased Receipts and Reduced Expenses.—Mr. J. M. McElroy, general manager, Manchester Corporation Tramways, has presented a report for the half-year ended September 30. It shows that the traffic receipts were £472,799, as against £460,339 in 1914 and £463,944 in 1913. "Other revenue" was £4,863, motor omnibuses £916, and parcel department (which increased from £1,861), £2,114. The total revenue was £480,692, against £467,681. Traffic expenses have been reduced by £17,342 to £278,106. The war allowance to men and dependents of men at the front amounted to £45,522 for the half-year. The total expenditure was £402,213, and there is a surplus of £78,479, against £95,330 in the corresponding period last year, when the pay to dependents for two months was only £2,330.

Cape Electric Tramways.—The directors' report for the year ended June 30, 1915, states that while the traffic has shown some expansion the state of war in South Africa has added considerably to the working costs, owing to the higher wages and allowances to employees on active service. The profit on the year, after providing for debenture interest and the redemption of debentures, amounted to £31,950. Including a balance of £12,337 brought forward from last year, there is a net credit balance of £44,287. The reserve fund receives £12,000, leaving a balance of £32,286. The directors recommend a dividend of 5 per cent. on the ordinary shares, an increase of 2½ per cent. on last year's distribution. This will require £24,561 and leave a balance of £7,725 to be carried forward. The passengers numbered 21,680,070, an increase of 793,924, and the traffic receipts were £206,123, an increase of £5,714. The directors again refer to the valuable services rendered by the local boards and general managers in Cape Town and Port Elizabeth and their respective staffs.

Melbourne Tramway and Omnibus Company.—The report presented at the annual meeting held in Melbourne shows that after paying 4s. per share in dividends and bonuses for the year, writing off £25,000 from the book values of freehold properties, and including £56,006 brought forward from last year, there is a balance of £152,580. A final bonus of 2s. per share was agreed to, and £38,630 was placed to general reserve account, bringing that fund up to £80,000. A balance of £17,950 was carried forward. Owing to the severe drought and the war, the traffic receipts were lower by £32,368. The Kew horse line was transferred to the local Council on November 2, 1914, and the Hawthorn horse line will shortly be taken over by the local Tramway Trust. The company has now entered upon the last year of its lease. As mentioned in last year's report, 10s. per share, amounting to £480,000, was distributed to shareholders on July 1, 1914, from realised assets. The directors have continued to realise investments representing the reserves, and on July 1, 1915, a further sum of 11s. per share, aggregating £528,000, was distributed.

East Ham Tramways.—The income for the past year was £60,570, an increase of £4,823. The expenditure was £51,957, an increase of £3,060. The gross profit was £8,613, against £6,850 for 1913-14. After meeting the customary charges and the deficiency of £7,523 brought forward from the preceding year, there was an adverse balance of £4,869. The percentage of operating costs to total revenue was 85·70; percentage of gross profits to average capital outlay, 3·5; total operating costs per car-mile, 7·75d.; length in miles of single track, 14·20; total car-miles, 1,596,984; number of passengers, 18,916,971; number of passengers per car-mile, 11·84; total revenue per car-mile, 9·05d.; traffic revenue per passenger, ·75d.; operating costs per passenger, ·65d.; number of units used per car-mile, 1·54; estimated population of district, 145,000; number of times population carried, 130; average fare charged per mile, ·63d. The disadvantage of halfpenny fares is shown by the fact that the average ride given for that sum is 1,457 yards, and the maximum 1 mile 418 yards. In opposition to the advice of Alderman Oakes, chairman of the Tramways Committee, the Council recently instructed the general manager to prepare a report abolishing the halfpenny stages and substituting shorter distances for a halfpenny fare. When the report came before the Council on October 24, Alderman Oakes said the new stages would drive people on to the omnibuses. It had been suggested that the omnibus companies would quickly follow suit; there was no guarantee of that. It seemed to be unfair to shorten the distance on one route without interfering with the stages on the other routes. The neighbouring authorities would not agree to any such scheme on the other routes. The report was adopted by a majority of four votes.

Newcastle Corporation Tramways.—The report of the general manager of the Newcastle Tramways, Mr. Ernest Hatton, for the year ended March 31, 1915, shows a considerable increase in the traffic and net profits. The number of passengers was 7¼ millions more than in the previous year, while the car-mileage increased 421,448 miles, including the lines over which the Corporation have running power. The net profit shows an increase of £5,152. The cars now traverse routes aggregating 69 miles of single track. An increase in traffic expenses of £7,436 is attributed to advances granted in the previous year being felt in full this year and also to further increases granted during the past year. The amount paid in rates has increased from £10,139 in 1913, and £16,252 in 1914 to £16,833, and the committee have lodged an objection against the valuation.

	1914-15.	1913-14.	Inc. or Dec.
Capital expenditure	£1,332,133	£1,284,380	+ £47,753
Loans outstanding	905,066	£929,766	- £24,700
Total track mileage	62·9	62·9	—
Number of cars in stock	223	200	+ 23
Reserve, renewals, and depreciation ...	£44,504	£50,204	- £5,700
Total renewals and depreciation ...	£115,301	£70,797	+ £44,504
Traffic revenue	£280,147	£251,024	+ £29,123
Total revenue	£293,264	£261,201	+ £32,063
Working expenses	£160,458	£147,552	+ £12,906
Gross balance	£132,806	£113,649	+ £19,157
Net profit	£43,757	£38,605	+ £5,152
Passengers carried	65,085,452	57,840,666	+7,244,786
Average fare per passenger	1·073d.	1·071d.	+ ·002d.
Car mileage	5,775,323	5,353,875	+ 421,448
Units per car-mile	1·968	1·922	+ ·046
Power cost per car-mile	·744d.	·804d.	- ·060d.
Traffic receipts per track-mile ...	£4,454	£3,992	+ £462
Traffic receipts per car-mile	11·642d.	11·169d.	+ ·473d.
Expenses per car-mile	6·668d.	6·614d.	+ ·054d.
Ratio of working expenses	53·02%	54·96%	- 1·94%

Provisional Order Restriction.—The Board of Trade give notice to parties contemplating the promotion of provisional orders in respect of electric lighting and tramways, gas and water, piers and harbours, that for the duration of the war the Board will not be prepared to entertain such applications except in cases in which they are satisfied that extreme urgency exists.

Russian Society for Electrical Enterprises, Limited.—This society, whose address is 5, Marsowo Polje, Petrograd, informs us that they are concessionaries of electric lighting stations in Pawlowsk, Uman, and Kamenetz-Podolsk, and of tramways in Elizabethgrad and Uman. The company have opened a branch for the sale of electrical machines and apparatus and insulating materials, and also of steam and naphtha engines as well as of water turbines. They desire to enter into relations with first-class factories in Great Britain producing these goods, with the view of becoming their agents in Russia. The company can offer the guarantee of the Russian and French Bank.

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CONTRACTS AND ORDERS.

Cape Town Council have accepted the tender of Siemens, Limited, for feeder cable and joint boxes at £4,776.

The Brush Engineering Company have completed the six new cars ordered for York Corporation Tramways.

Improved Wood Paving Company have received an order from East Ham Council for wood blocks at £8 10s. per thousand.

Edison and Swan United Electric Light Company have received an order for the supply of fuse boards to the Metropolitan Water Board.

R. H. Gould and Company have received a contract to supply eight 100 KW. single-phase transformers for Johannesburg Electricity Works.

Melbourne Council have placed a contract with the Reason Manufacturing Company, Brighton, for the supply of direct current meters.

Launceston (Tasmania) Council have allotted a contract to the British Insulated and Helsby Cables for armoured feeder cable and accessories.

Workington Iron and Steel Company, Limited, have received an order for rails, of British standard section, from the Crown Agents for the Colonies.

H.M. Post Office has awarded the following contracts:—Motor chassis, D. Napier and Son, Limited; arc lamp carbons, General Electric Company.

The Pneumatic Engineering Appliances Company, Limited, have received an order for a pneumatic moulding machine at £150 from London County Council.

Scholey and Company, Limited, 56, Victoria Street, London, S.W., have received an order for gear wheels and pinions for car motors from Bradford Corporation.

Sydney Council have placed a contract with the British Westinghouse Electric and Manufacturing Company, Limited, Manchester, for a 2,000 KW. rotary converter.

British Westinghouse Company's tender for the supply of a motor converter and rotary converter to Sydney Council has been recommended for acceptance, at £6,143.

The Dunlop Company have received an order from York Corporation for the maintenance of the tires on the battery-driven omnibuses at a sum per omnibus mile.

Edgar Allen and Company, Limited, Sheffield, are supplying points and crossings to Southampton Tramways Committee, and special track work to Glasgow Tramways Committee.

Edinburgh Council have accepted the tender of Messrs. Fraser and Chalmers for turbo-alternators and condensing plant, to be installed in the Portobello new power station.

Bradford Tramways Committee have placed a contract with the British Oxygen Company, Limited, for a supply of oxygen during the ensuing quarter, at 35s. per 1,000 cubic feet.

Rotherham Council have placed a contract with Messrs. Briggs, Jones, and Gibson, Limited, for motormen's overcoats at 32s. 6d. each, and conductors' overcoats at 27s. 6d. each.

West Ham Council have been recommended by the Electricity Committee to accept an offer by the British Westinghouse Company to supply a new motor for the 2,300 KW. turbo-alternator.

War Office contracts have been placed for ballast wagons with the Rolling Stock Company, Darlington, and for traction engine wheels with Aveling and Porter, Limited, and Ruston, Proctor an Company, Limited.

Erith Council have allotted tenders as subjoined:—Fraser and Chalmers, Limited, supply and delivery of a turbo-alternator and condensing plant, £10,432; H. Friday and Sons, extension of the generating station, £1,420.

J. W. Courtenay, Limited, of Amberley House, Norfolk Street, London, W.C., have been appointed sole advertising contractors for the Perth Corporation Tramways. The contractors' remuneration is to be computed on a commission basis.

Plymouth Tramways Committee have accepted the tender of the Brush Electrical Engineering Company to supply the bodies of six new cars, and that of the British Westinghouse Electric and Manufacturing Company to electrically equip the cars.

Sheffield Council have placed a contract with G. Longden and Son, Limited, for the construction of foundations to four new boilers at Neepsend power station, and with Staveley Coal and Iron Company, Limited, for the supply of cast-iron cable pipes.

Glasgow Tramways Committee have accepted the following tenders:—Mavor and Coulson, Limited, switchboard; A. Watson and Company, and Crompton and Company, Limited, electric heaters for Govan depot; C. D. Monninger, Limited, woodworking machine irons.

Chas. Macintosh and Company, Limited, of Manchester, have received an order from Manchester Corporation for the supply of macintosh capes for special constables, and from Northampton Tramways Committee for motormen's and conductors' waterproofs at 32s. 3d. each.

Derby Tramways Committee have placed an order for copper wire with the British Insulated and Helsby Cables, Limited, and for wood blocks with Millar's Trading Company, Limited. Messrs. Parsons and Company, Limited, have received an order for the repair of a steam turbine at £800.

The Bell Punch and Printing Company have received a renewal of their present contract with Bolton Tramways Committee for the hire of punches for a further period of three years. The committee have also accepted the company's offer to supply tickets for a further three months on the same terms as the last contract.

Glasgow Coal Contracts.—On one large contract for coal, Glasgow Tramways Committee have effected a saving of 2s. 10d. per ton, as compared with the offers made to the committee in April last. On other lots the saving ranges from 6d. to 3s., and the average reduction on the recent contracts is about 2s. per ton.

W. T. Henley's Telegraph Works Company have obtained a contract for the supply of an electric lighting main in connection with the lighting of refuges on the Victoria Embankment by the London County Council. The company have also undertaken the linking up of the two generating stations at Battersea and Fulham.

Babcock and Wilcox, Limited, have received a contract to supply and erect a water tube boiler, with superheater, economiser, automatic stoker, steel chimney, induced draught plant, steam valve, pipes, etc., to Erith Urban Council, at £5,054. The company have also received a contract from Halifax Tramways Committee for a water tube boiler and superheater at £2,940.

Liverpool Tramways Committee have accepted the subjoined tenders:—Grey greatcoat cloth and milled Melton cloth, H. Booth and Sons, Gildersome; coat lining, J. Hoyle and Son, Longwood; making up 1,500 drivers' and conductors' jackets, J. Hunter and Son, Liverpool; 1,500 caps for drivers and conductors, A. D. Legg and Company, Liverpool; 120 caps for inspectors and time-keepers, Coop and Company, Wigan.

The India Office have placed the appended contracts:—Rail anchors, the Railway Track Supply Company, Gracechurch Street, E.C.; axles, J. Spencer and Sons, Newcastle; tires, Taylor Brothers and Company, Leeds, and Brown-Bayleys Steel Works, Sheffield; wheels and axles, Schven Steel Wheel Company, Leeds; cable, Callender's Cable Company, Shropshire Iron Company, Pirelli Cable Company, and W. T. Glover and Company.

Manchester Tramways Committee have awarded contracts as follow:—

J. Hainsworth and Sons, Leeds, beaver for uniform clothing; R. Gaunt and Sons, Limited, Leeds, serge for uniform clothing; W. Lupton and Company, Leeds, serge and pilot for uniform clothing; Briggs, Jones and Gibson, Limited, making up of uniform clothing; Williams and Richardson, New Road, London, E., timekeepers' and traffic inspectors' cloth caps; N. Hope and Son, Cheetham, drivers', guards', and point boys' cloth caps; W. Walsh and Sons, Luton, timekeepers' straw caps; C. Dillingham and Sons, Luton, drivers', guards', and point boys' straw caps; Kelsall Brothers, Ardwick, furnace and house coal; J. Smith and Company, Higher Ardwick, anthracite coal.

Manchester Electricity Committee have placed the following contracts:—

Ferranti, Limited, sub-station switchgear; Ferguson, Pailin and Company, Limited, high and low tension switchboards for sub-station; Ferranti, Limited, two 200 K.V.A. oil-cooled transformers for sub-station; British Westinghouse Electric and Manufacturing Company, Limited, one 200 K.V.A. oil-cooled transformer for sub-station; British Thomson-Houston Company, Limited, and Switchgear and Cowan's, Limited, Salford, circuit breakers; British Electric Transformer Company, Limited, auto-balancers and auto-transformers; Pirelli General Cable Company, Limited, Siemens Brothers and Company, Limited, cable; British Insulated and Helsby Cables, Limited, paper-insulated service cables; Richardsons, Westgarth and Company, Limited, Hartlepool, 15,000 KW. turbo-alternator; Babcock and Wilcox, Limited, watertube boilers.

Portsmouth Council have placed contracts as subjoined for the supply of tramway stores and materials:—

Engine packings, asbestos goods, etc., Pryke and Palmer, Thermofelt, Limited, Beddam Packing and Rubber Company, Limited, and Sutcliffe Brothers; Welsh steam coal, Pensford and Bromley Collieries, Limited; wood paving blocks, Millars Timber and Trading Company, Limited, and Acme Flooring and Paving Company (1914), Limited; controller fingers, Engineering Supplies Company; car gear wheels and pinions, F. W. Rowlands and Company; trolley wheels and bushes, Fleming, Birkby and Goodall, Limited; armature binding wire, Marsh Brothers and Company, Limited; sheet fibre, mica, mica cloth, tape, and other insulating materials, Spicer Brothers, Limited, Micanite and Insulators Company, Limited, J. G. Ingram and Son, Cooper and Roberts, Mica Manufacturing Company, and British Westinghouse Electric and Manufacturing Company, Limited; armature coils, P. R. Jackson and Company, Limited; incandescent lamps, British Thomson-Houston Company, Limited; overhead line materials, Fleming, Birkby and Goodall, Limited, Carr Brothers, Limited, and London Electric Wire and Smiths, Limited.

The Mirrlees Watson Company have recently received orders for the following condensing plant:—Booker Brothers and McConnell, London; W. G. Armstrong, Natal, for the Verulam Estate; Greenwood and Batley, Limited, for Tinsley Park Colliery (second set); Scottish Central Electric Power Company, Limited, Bonnybridge Power Station (second set); Rossington Main Colliery (second set); Tharsis Sulphur and Copper Company, Limited (two sets); St. Helens Corporation (third set); G. Wilkinson, Natal, for "Ottawa"; Societe Anonyme Westinghouse, Paris, for Dieppe; Fraser and Chalmers, for North Lonsdale Iron Company. The Mirrlees Watson Company have also received orders for Edwards' air pumps from McArthur and Orkney, Limited, Greenock, and Compagnie Française Thomson-Houston; and for dry air pumps from Sociedade Agricola de Cassequel Limitado, Lisbon, and Houghton Main Colliery Company.

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PERSONAL.

Senor Alvarez Cortes has been appointed by the Uruguay Government as manager of their electricity works.

Mr. J. A. H. Clifford has been promoted to the position of senior engineer-in-charge of Belfast electricity works.

Mr. A. Race, borough engineer and surveyor of Barrow-in-Furness, has been appointed to a similar post at Blackburn.

Mr. P. H. Frankel has been appointed lecturer on electrical engineering at the University of Perth, Western Australia.

Alderman W. P. Gibbings, chairman of Carlisle Electricity Committee, has accepted the mayoralty for the ensuing year.

Messrs. McCarty, Underwood and Company have been appointed consulting engineers to Footscray (Victoria) Council for their tramway scheme.

Mr. R. W. L. Phillips has been awarded a sum of fifty guineas by Bedford Council for work done outside of his duties as borough electrical engineer.

Mr. J. E. Kingsbury has been elected honorary treasurer of the Institution of Electrical Engineers in succession to the late Mr. Robert Hammond.

Mr. E. Cochrane, assistant electrical engineer to Sydney Council, has been appointed general manager and chief engineer to Brisbane Electric Light Company.

Mr. W. Dundas Fox, of the electrical department of Bradford Corporation, has received an appointment with the British Westinghouse Company at Trafford Park.

Mr. J. F. Avila, who for nine years has been the London manager of Simplex Conduits, Limited, has been appointed works manager at the Birmingham works of the company.

Mr. S. H. E. Barraclough has been appointed to the chair of mechanical engineering at Sydney University. Mr. Barraclough has been lecturer in mechanical engineering at the University.

Mr. A. Wilson, on a recommendation made by the city electrical engineer, has been appointed to the new position of power-house economist for the Sydney Municipal Council. The salary is £375 per annum.

Mr. S. P. Cook has been presented with a case of pipes and a pouch by the staff of St. Pancras Electricity Works on leaving to take up the position of senior shift engineer at Nechells power station, Birmingham.

Professor V. B. Lewes, who died on October 23, was professor of chemistry at the Royal Naval College, Greenwich. He had taken great interest in researches relating to substitutes for petrol as fuel for motor-cars.

Mr. Frank J. Sprague, an American pioneer in electric traction, is one of the electrical experts who have been chosen to form part of the American Naval Advisory Board, under the presidency of Mr. T. A. Edison.

Mr. E. Pelham Bennett, manager of the Liverpool staff of Simplex Conduits, Ltd., has been promoted to the position of manager of the London and South of England district of the company. On leaving Liverpool he was presented with a silver cigarette case by the staff.

Mr. C. L. Oechsner, who for many years has been in charge of the Rugby advertising of the British Thomson-Houston Company, has gone on a visit to Boston, from whence he proposes to go to Schenectady and New Orleans, then to the Pacific Coast, California, returning via New York.

Traffic Superintendent for Chester.—The Tramways Committee recommend that they be authorised to appoint a traffic superintendent of the tramways at a salary of £120 per annum, rising by annual increments of £5 to a maximum of £150 per annum, with house, coal, and lighting.

Mr. H. Broadbent, engineer and manager of the electricity works of Perth, Western Australia, has returned to England to assist in munition work. He has been in Perth since 1896, when he erected the first important electrical plant in the State. On leaving he was presented with numerous gifts, and there was a farewell meeting of the Municipal Council in his honour.

Mr. Frank Wilkinson, deputy borough surveyor of Wimbledon, who has been appointed borough engineer of Deptford, was from May, 1903, engineering assistant in the tramways and bridges department of Rochdale Corporation. Early in 1907 he was appointed to Wimbledon out of nearly 200 candidates, and he has carried out many important works in that London borough.

West Ham Appointments.—The following appointments to the tramway staff have been made by West Ham Corporation:—Mr. J. W. B. Carruthers, civil engineering assistant, at £250 per annum; Mr. E. Ainsworth, surveying assistant and draughtsman, £120 per annum; Mr. W. G. Smith, general foreman, £3 5s. per week; and Mr. G. Bourne, foreman platelayer, £2 5s. per week.

Mexican Tramways Officers' Experiences.—It is stated that the Revolutionary Government in Mexico refrained from expelling the British officers of the Mexican Tramways, but appointed a second set of officials. These were Mexicans, and they pass their time in watching the English staff do the work. The latter receive their salaries from the London office; the Mexicans draw theirs from the Government. An important part of the work of the English staff is to prevent misuse and deterioration of the rolling stock.

Messrs. Markham and Prance, consulting engineers, Dudley House, Southampton Street, W.C., have dissolved their partnership for the period of the war. Mr. Markham is serving as chief inspecting officer of aeroplane engines, R.N.A.S., and Mr. Prance obtained a commission soon after the outbreak of the war in the first reserve unit of the 3rd Royal Fusilier Battalion of the London Regiment (T.F.). He is now second in command, the battalion being in the Near East.

The Hon. Arthur Stanley, M.P., chairman of the Joint War Committee of the British Red Cross Society and the St. John Ambulance Association, on the conclusion of a year's work of that committee, has received a letter from Sir Alfred Keogh, director-general of the Army Medical Services. Sir Alfred congratulates Mr. Stanley on behalf of the Army on the splendid help which the Joint Committee have afforded to the sick and wounded soldiers of the Empire and our Allies in all the theatres of war as well as in this country.

Lieut.-Colonel A. C. Joly de Lotbiniere, who has been elected a director of the Rangoon Tramway and Electric Supply Company, Limited, is a distinguished engineer and well known in India. He suggested and carried into effect the first large hydro-electric transmission power scheme in the East, that from the Cauvery Falls to the Kolar Goldfields of Mysore. Since then he has been engaged on the harnessing of the River Jhelum in Kashmir, for similar purposes, the Abbotabad-Srinagar Railway depending for its motive power on the hydro-electric power installation on the Jhelum. The gallant officer is now serving in France, and has been promoted to Major-General.

Mr. W. W. Lackie's tour in America as city electrical engineer to Glasgow Corporation, was referred to at a luncheon following an inspection by the Electricity Committee of the new generating station now in course of erection. Bailie W. B. Smith, the chairman, stated that they had been able to save an immense amount of money as the result of Mr. Lackie's visit. The first installation would result in a saving in cables to the amount of £19,000, and when the whole installation was completed they would save £174,000 in cables owing to the adoption of the high tension system. In a year or two 60,000 horse-power would be developed, and when the works were completed they would get 200,000 horse-power. The total cost would be £1,500,000.

RAILWAY OFFICERS AND STAFF.

Mr. T. J. Callaghan has been elected a director of Barry Railway.

Mr. Charles Gardiner has been elected a director of the Central Argentine Railway Company.

Mr. S. J. Tatem, the head of a Cardiff shipping firm, has been elected a director of Cardiff Railway and Docks.

Mr. R. Graham has been appointed secretary of the Buenos Ayres Western Railway to fill the vacancy created by the death of Mr. F. Eustace Faithfull.

Mr. C. Cumming, a district locomotive superintendent of the North British Railway, has been appointed locomotive superintendent of the Highland Railway.

Mr. J. R. Cooper has been appointed inspector of the Bath district office of the Railway Clearing House, succeeding Mr. C. Powell, who retired after fifty years' service.

Mr. J. R. More has been appointed assistant director of railways in the South-West Protectorate in Africa, recently taken from the Germans. His headquarters are at Windhuk.

Major H. S. K. Woodhouse, who has received promotion to that rank from captain in the Liverpool Regiment in France, is connected with the engineering department of the London and North-Western Railway at Crewe.

Mr. H. G. Smith, of the general superintendent's department of the Midland Railway at Derby, has been awarded the first prize in an essay competition on "The Value of Railways in Time of War." He is now serving with the Royal Engineers in France.

Mr. C. F. Bengough, chief engineer to the North-Eastern Railway, will for the time being take charge of the dock engineering of the company, as the directors have decided not to appoint at present a docks engineer in succession to the late Mr. C. Watson.

Mr. Walter Horne, managing director of the Burma Railways Company, was a year ago appointed as a director of the Barsi Light Railway. In the company's report for the past year Mr. Horne's long experience of light railways in India is referred to as having been of great value to the company.

Mr. E. A. Moore has relinquished his appointment as solicitor to the Great Eastern Railway, which he had held since 1888. Mr. T. Chew, assistant solicitor to the Great Eastern Railway, has been appointed to succeed Mr. Moore as chief solicitor, and Mr. E. Wybroo takes the place vacated by Mr. Chew.

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Captain J. T. Lewis, who is reported missing in the Dardanelles, was the chief engineer of the South India Railway. He was an officer in the Volunteer Corps attached to that railway. At the outbreak of the war he was in England on leave, and he obtained a commission in the Lincoln Regiment.

Canadian Pacific Railway Executive.—Sir Thomas Shaughnessy was re-elected president, and Mr. G. Bury vice-president at the annual meeting. To constitute the Executive Committee the following were appointed :—Mr. R. B. Angus, Mr. G. Bury, Sir Herbert Holt, Sir E. Osler, and the president.

Mr. Harold Brown, who has been appointed engineer of the Maryport and Carlisle Railway, entered the office of Mr. Cartmell, whom he has succeeded, in 1897. In 1913 Mr. Brown obtained the degree of Bachelor of Science (Engineering) at London University, and in January last he was elected an associate member of the Institution of Civil Engineers.

Mr. Alexander Charles, secretary to the Midland Railway, has completed fifty years' service with the Midland Company. He became junior clerk in the accountant's department in 1865, and was appointed assistant secretary in 1883. Sixteen years later he became secretary. Besides being secretary to the Midland Railway, he holds the same position on the Somerset and Dorset and Tottenham and Forest Gate Railways. Mr. Charles has been president of the Chartered Institute of Secretaries, and was for several years chairman of the Railway Servants' Orphanage Concert Committee, whose concerts under his management realised nearly £2,000.

WAR APPOINTMENTS.

Mr. H. Wood, deputy city engineer, Norwich, has received a commission in the Royal Engineers.

Mr. R. J. Samuel, engineering inspector to the Road Board, has received a commission in the Royal Engineers.

Mr. J. Brierley, district surveyor, of Sheffield, is among the members of the staff of the city surveyor who are serving with the forces.

Mr. A. H. Gates, on being released from army service, has been re-engaged as chief technical assistant to the borough electrical engineer, Luton.

Captain G. C. Milnes, borough electrical engineer of Lancaster, has been promoted to the adjutancy of the 5th King's Own Royal Lancaster Regiment.

Mr. Edward Stead, county surveyor of Somerset, has received a commission as lieutenant in the Royal Engineers, for service with the 4th Labour Battalion.

Corporal C. W. Saunders, formerly inspector with Portsmouth Corporation Tramways, has been instrumental in inducing fifty of the Portsmouth employees to enlist.

Mr. O. Cattlin, assistant engineer to the borough of Holborn, has been gazetted as lieutenant in the London Territorial Sanitary Company, Royal Army Medical Corps.

Mr. A. C. Gilling, who was resident engineer at Epsom at the outbreak of the war, has been granted a commission in the Royal Flying Corps, after nine months' service in France with the Queen's Westminster Territorials.

Mr. C. Jackson, an employee of Sheffield Corporation Tramways, on October 8 was gazetted second lieutenant in the 2nd North Midland Brigade, R.G.A., after four months' service in the Inns of Court Officers' Training Corps.

Mr. R. W. Hughman, managing director of the *Electrical Times*, has been appointed to a captaincy in the 2nd Battalion, 9th Middlesex (Territorial) Regiment. Captain Hughman joined the regiment as second lieutenant in August, 1914.

Mr. J. M. McElroy, general manager, Manchester Corporation Tramways, has been invited by the Ministry of Munitions and the Board of Trade to advise them on the best means of dealing with the transit difficulties in one of the London munition areas.

Sergeant M. Rathborne, formerly the popular manager of the Oldham, Ashton, and Hyde Tramways Company, but now of the 10th Battalion King's Royal Rifles, is brother to Mr. W. Rathborne, the accountant of the Dublin United Electric Tramways Company.

Lieutenant J. A. Baker, who went from his position as an assistant electrical engineer in the traction department of the British Westinghouse Company in order to join the Army Service Corps on the outbreak of the war, is now in command of a heavy battery in France.

Seaman H. H. Purnell, of the Neasden power station of the Metropolitan Railway, has been twice commended for gallant conduct in action with the Hood Battalion of the Royal Naval Division at Cape Helles, Gallipoli, and has been awarded the distinguished conduct medal.

Second Lieutenant H. Irwin, of the office staff of Newcastle Corporation Tramways, is mentioned in the annual report of the general manager as being the first member of the Territorial Force to receive the D.C.M. in the war. He was awarded the distinction for gallant conduct in Belgium last November, when he was sergeant in the Northumberland Yeomanry. He was invalided home, and has been given a commission. The lieutenant is now training recruits for the reserve unit of his regiment.

OBITUARY.

Mr. W. A. LUNTLEY.

We regret to record the death of Mr. William Aubrey Luntley, general manager of the Wolverhampton Corporation Tramways, which occurred on October 25, after an illness of over seven months. The illness originated in a fall while he was engaged in scouting with the local Volunteer Corps in March last. Mr. Luntley was 42 years of age, and had been engaged in tramway work since his early manhood. He had been manager of the Wolverhampton tramways since 1902, and was universally esteemed and respected by all with whom he came in contact. The Council, committee, officials, and staff are unanimous in expressing their grief at the sad news of his untimely death, which all members of the tramways department feel as a personal loss. This was shown by the representative attendance at the funeral. The first part of the service was read in St. George's Church, when the pathway to the entrance was lined by members of the Volunteer Corps and by tramway employees.

Six motormen acted as bearers. Among the numerous floral tributes were wreaths from the Mayor (Ald. Bantock), the Mayoress, Sir C. T. Mandor (chairman, Tramways Committee), Ald. S. Craddock (vice-chairman), and the members of the Tramways Committee,

The late Mr. W. A. Luntley.

Mr. C. O. Silvers (tramways engineer and deputy manager), and the tramways official and maintenance staffs, Mr. S. T. Allen (borough electrical engineer) and the Electricity Committee, the inspectors, motormen, and conductors, and the tramways fishing and football clubs ; Sir H. Brevitt (Town Clerk), and members of the Corporation. The large congregation also included Mr. R. L. Horsfield (general manager, Walsall Corporation Tramways) and Mr. Comber, of the Birmingham and Midland Joint Tramways Company.

As evidence of the esteem entertained for Mr. Luntley by the employees, we may mention that a motorman who acts as secretary to the men's union wrote in an appreciation of the deceased manager published locally, "Always courteous and full of sympathy for those under him, we feel that we have lost a brother. His death will be mourned on the battlefields of Flanders and Gallipoli by our comrades, who will miss his cheery words. He was a firm believer in trade unionism, and did whatever he could to make things smoother and brighter for the employees. The covered ends of the cars had his heartiest support, and how he got them nearly all done will ever be a monument to his memory. His tact and wisdom in dealing with the various matters that came to his notice were unique."

Captain W. Casson, who was killed in the recent fighting on the West front, was chief assistant to the mechanical engineer of the District, London Electric, and London Central Railways.

Corporal G. E. Broome, 6th Battalion Manchester Regiment, who died on a hospital ship coming from the Dardanelles, was for five years employed in the offices of Manchester Corporation Tramways.

Lieutenant A. Leslie Hamilton Jacob, 18th Battalion London Irish Rifles, has been killed in action in France. Lieut. Jacob, who was 19 years of age, was the only surviving son of Mr. A. Jacob, of the British Aluminium Company, Limited. He was gazetted in September last, and obtained promotion in May.

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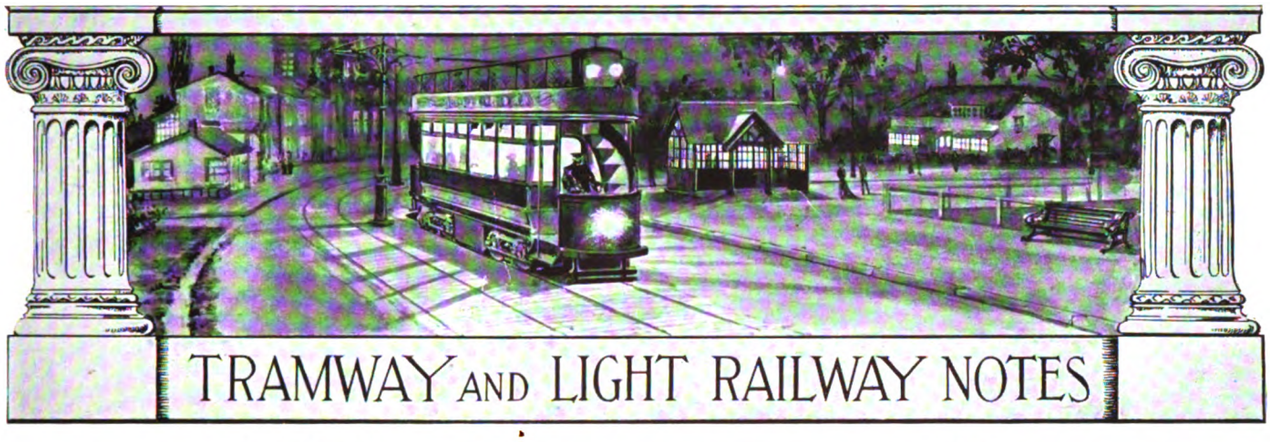

TRAMWAY AND LIGHT RAILWAY NOTES

BIRMINGHAM.

APPEAL FOR VOLUNTEER MOTORMEN.—EMPLOYEES' PATRIOTISM.—TOWN PLANNING AND TRAMWAYS.

Five hundred and fifty names have been received by the Tramways Committee in response to their appeal to professional and business men ineligible for the Army to become motormen. Owing to the shortage of motormen among their employees, the Committee are unable to adequately respond to the request which has been made for increased facilities for the transport of munition workers. The total number of members of the Tramways Social, Athletic, and Thrift Club who have joined the Forces is 1,134. Fifty-two have been reported killed, three have received commissions, and one the Distinguished Conduct Medal. Another has been recommended for the latter award. Lecturing on town planning to the Birmingham and Midland Scientific Society, Mr. G. Cadbury, jun., described a proposal to make a road 100 ft. wide, on which the tramways would be laid on one side and given a space of 34 ft. Thirty-five ft. would be set apart for vehicular traffic, while the remainder would be allotted to footpaths. With a system of this kind it was estimated a saving would be effected in the running of the cars of an amount equivalent to ½d. per car-mile. In addition to four town planning schemes undertaken within the city, there were schemes for Sutton Coldfield, Oldbury, and Rubery.

BRADFORD.

FEWER STOPPING PLACES.—PROPOSED REVISION OF FARES AND STAGES.—NEW ASPECT OF CHILDREN'S FARES.—AUTOMATIC TROLLEY CHANGING.—SUSPENSION OF EXPENDITURE.

Under a scheme prepared by Mr. C. J. Spencer, the general manager, and adopted by the Tramways Committee, a little over 8 per cent. of the stopping places have been abolished during the present time of emergency. The new system of working was introduced in the third week in October for the purpose of facilitating the traffic. Besides a saving of time it is urged that fewer stops will lessen the demands made upon the depleted staff of the repair shops. The Corporation, on October 12, instructed the committee at the end of the financial year to prepare a scheme for the revision of fares and stages on all the tramway routes. This decision was arrived at in consequence of a complaint that the penny stages were not equal in length. Councillor E. Priestley, chairman of the committee, said that when the war was over it might be possible to have a universal penny fare within the city, but in the present difficult times it was going to be difficult to show a profit. Reference is made in the annual report of the Tramways Department to an application from the Education Committee, in pursuance of their policy of establishing schools in the outlying and healthier parts of the city. In response, the Tramways Committee decided to carry children at a uniform rate of ¾d. per head to and from school, irrespective of the distance travelled inside the city boundary. At several of the tramway termini an automatic device is being used for changing the trolley of a car from the down to the up line. It has given great satisfaction to the conductors, especially now that lighting is restricted. In consequence of the action of the Treasury, the Tramways Committee have deferred the work of reconstructing the Thornton Road tramways, and have asked the officials to consider further the question of maintaining the service by means of track repairs. Exclusive of the new mess room, the work under contract at Thornbury workshops extension has also been postponed.

GLASGOW.

SUGGESTED USE OF WOMEN AS DRIVERS.—TO LESSEN ROAD DANGERS.

Several women who have been employed as conductors are being trained to undertake the duties of motormen if such a development is found feasible when an experiment has been made. The tramways manager has issued an appeal to drivers of slow-going vehicles to keep as near the kerb as possible, especially in foggy weather. Of late the Corporation have not been able fully to carry out the work of supervising slow-going vehicles.

LEEDS.

WOMEN BECOME CONDUCTORS.—IMPROVED STREET LIGHTING.—LACK OF RAILLESS CAR DRIVERS.—INCREASED TRAFFIC.

Towards the end of October women between the ages of 21 and 35 years made their appearance as conductors on the Corporation tramcars. Some of them are wives of employees who are now serving with the Forces. The women work eight hours a day for six days a week, and are paid at the rate of 27s. 6d. a week. The aptitude which they are showing for the work has surprised Mr. A. Daggett, the traffic superintendent, and the inspectors who supervise their training. They are being trained in batches of 25, and it is expected that 300 women will ultimately be employed. In order to lessen the dangers of the streets during the longer hours of darkness an improvement has been made in the lighting. More traffic is being offered on the new railless trolley car route between Guiseley and Otley than the two cars running can carry. Owing to the lack of drivers and conductors no further cars can be put in service. Mr. J. B. Hamilton attributes the exceedingly high revenue earned in August, September, and October to the good trade in the district, the fine weather, and the absence of cheap railway fares. Although the supply of labour has fallen off the car services have been maintained at practically the same level during those months. With the aid of female conductors the Corporation hope to extend the tramway facilities. The traffic returns for the nine weeks ended October 4 for the years 1913 and 1915 show that the total receipts for the former period were £76,411, and for the latter £82,399. The mileage has also increased.

LONDON.

SANCTION FOR WOMEN CONDUCTORS.—REMOVAL OF TRAIL CAR RESTRICTIONS.—MUNITION TRAFFIC PROBLEM.

The Commissioner of Police, on October 21, announced that he was prepared to issue to suitable women licences to act as tramcar and omnibus conductors. The Board of Trade have agreed to the running of trail cars during the war at all times of the day on the authorised routes. Hitherto the running of the passenger trailers has been limited to certain periods of the day. Additional trailers are about to be delivered, and it is hoped to place some of them on southern routes that have not hitherto been provided for. The Board of Trade and the Ministry of Munitions have requested Mr. J. M. McElroy, general manager of Manchester Corporation Tramways, to advise them on the best means of dealing with the transit difficulties of one of the munition areas. At present almost the whole of the burden is borne by the tramways, the railway service being quite insufficient as well as inaccessible. Until additional power is available, the tramway service cannot be increased. Five hundred employees of the London United Tramways Company had joined the forces up to the beginning of October, this total representing 40 per cent. of the entire staff. There have been numerous casualties. Twelve have returned to work on discharge as being unfit for further active service.

MANCHESTER.

WOMEN CONDUCTORS.—"SAFETY FIRST."—WAR COLLECTIONS.

The female conductors began duty on the Manchester tramcars on October 9. Many of the car tickets issued on Manchester cars have the following inscription on the back: "Safety first. To board or alight from tramcars whilst they are in motion is a dangerous act, and causes many accidents. If you do it, you may have an accident." According to a return presented to the Tramways Committee for the six months ended September 30, the city tramways hold a record for the largest amount realised by war collections. Out of £23,500 raised by such means in England and Wales, the sum of £14,000 was collected on the Manchester cars. The largest sum received was £7,123 for the local relief fund, followed by £692 for Belgian refugees, £558 for the Belgian wounded. Among 22 other collections, £391 was raised for motor ambulances and £432 for the British Red Cross.

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OLDHAM.

MOTORMEN BELOW STANDARD HEIGHT.—SHORTAGE OF WORKSHOP EMPLOYEES.—EMPLOYEES' PATRIOTIC COLLECTIONS.

Reporting to the Tramways Committee, Mr. W. J. Dugdale, general manager, has stated that the shortage of men continues, and there are men driving who were only 5 ft. 5 in., the standard height in normal times being 5 ft. 7 in. Referring to a visit he had paid to London to attend a conference and to call at the office of the Minister of Munitions with regard to a case recently dealt with by the local tribunal, Mr. Dugdale said that he objected to a turner leaving the car works. At the present time he had not a single turner, and his visit might be the means of preventing fitters and turners leaving. On October 21 the general manager, along with six employees who represented different branches of the department, handed to the Mayoress (Mrs. Lees) a cheque for £100 in aid of the Red Cross Society. Mr. Dugdale stated that the department, through the collections upon the cars, had also been able to hand to the Mayoress the sum of £272, besides themselves contributing £195 to the local relief fund, and £20 for Alexandria Hospital Fund. The Mayoress said she considered the men had been very thoughtful and had realised by weekly contributions a handsome amount.

PORTSMOUTH.

TRACK CLEANSING.

In his report to the Tramways Committee for 1914–15, Mr. W. R. Spaven, the general manager of Portsmouth tramways, states that the cleaning and sanding of the track cost £412 more than in the preceding year. The increase is attributable to the cost of running the water wagons more often than formerly on account of dispensing with the brushes on the cars.

RAWTENSTALL.

DINNER HOUR TRAFFIC.

For a period of six months a trial is to be given to the issue of double tickets so as to enable workmen to go home to dinner. The tickets have to be purchased in the morning, and are available from 12 to 2 p.m., but they will be issued only for 1½d. stages. The time required for travelling will not permit of an extension to the 2d. stage.

WOMEN CONDUCTORS AT SOUTHAMPTON.

In July last the shortage of conductors became so marked on the Southampton Corporation Tramways that the general manager had to resort to the employment of boys. At the same time Alderman F. A. Dunsford, J.P., the chairman of the Tramways Committee and Mr. W. T. Robson, general manager, visited Portsmouth, and

A Group of Women Conductors at Southampton.

witnessed the work of the women conductors on the cars there. Shortly afterwards applications were invited from women to serve as conductors on the Southampton cars. There were 300 applicants for less than 50 positions. The women wear a dark grey gaberdine tunic and skirt piped with red, with hat to match.

Increased Fares Justified at Leicester.—Referring to a petition received against the increased fares at Leicester, Alderman S. Flint, chairman of the Tramways Committee, has stated that the new fares have been more than justified by the returns.

PATENT LIST.

Specially abstracted for "The Tramway and Railway World" from the Official Journal of Patents.

*** If the inventions have been communicated the names of the communicators are given below in italics.

APPLICATIONS FOR LETTERS PATENT.

13,691 Low-fare traffic facilitating mechanism—S. G. Kayas.
13,770 Lubricating bearings of railway wagons—T. H. Simpson.
13,774 Electro-magnetic power transmission for motor cars—J. Dollard and H. W. Brown.
13,799 Ignition systems for motor vehicles—O. D. North.
13,842 Motor vehicles—W. Daly.
13,930 Construction of motor chassis—F. C. R. Johnson.
13,996 Rail crossings—J. K. Kendrick.
14,121 Means for connecting electrical conduits—F. W. Uren.
14,146 Railway splay joint—A. Sönsthagen.
14,197 Railway facing points—F. W. Woodward.
14,296 Compression brake for motor vehicles—J. Davies.
14,341 Gear boxes for automobiles—T. Gill.
14,360 Track ramps for signalling and train stopping apparatus—H. Ballington and L. Shaw.
14,372 Fenders for motor omnibuses—W. E. Dimberline.
14,472 Actuating signals on and communicating with trains—H. A. Thompson.
14,483 Brakes for motor vehicles—C. H. Roe and the R. E. T. Construction Company, Limited.
14,494 Railway trucks—E. Peckham.
14,544 Automatic couplings—F. C. Stevens.
14,548 Electro-mechanical driving arrangements for vehicles—H. Reik and another.
14,549 Motor trains—H. Reik and another.
14,599 Motor lorries—W. F. Richards and F. Patrick.
14,659 Motor road vehicles—F. Sumner-Smith and R. P. Yates.
14,741 Brake-operating mechanism for street cars—J. S. McWhirter.
14,790 Device for facilitating the engagement of trolley wheels with overhead trolley lines—H. Lowe.
14,879 Storm shield for top of omnibus seats—O. Wyatt.
14,909 Rear springing of mechanically-propelled vehicles—J. A. Getty.

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14,948 Wheels and tires of motor vehicles—L. H. Swain.
15,303 Systems of distribution for electrically-operated railway trains—P. S. Turner.
15,304 Controllers for electric vehicles—P. S. Turner.

Specifications Published.

1914.

19,564 Interchangeable wheels for motor vehicles—Baker, Foley and Baker Rim Company.
23,802 Sleepers for permanent way—Sandberg.
19,977 Electric lighting and heating of railway vehicles—Vidal.
20,196 Locking mechanism for use with railway signals—Railway Signal Company and Roberts.
20,046 Signalling system for municipal traffic control—Hoge.
20,173 Passenger train communication system and apparatus—Willans, Luard and Consolidated Brake and Engineering Company.
24,122 Starting mechanisms for motor car engines—Fillettaz.
20,166 Joints on tramway and railway rails—Fox.
20,423 Underframes for railway vehicles—Spencer.
23,535 Top deck seating arrangements for omnibuses—Hickman.
20,557 Catenary supports for electric conductors—British Thomson-Houston Company (*General Electric Company*).
24,045 Motor vehicles—Scott.

1915.

638 Oil-returning device for bearings—Albion Motor Car Company and Murray.
356 Underframes for railway vehicles—Wade (*Lloyd*).
6,712 Switch with rocking tongue for tramways and railways—Grimaldi.
1,078 Railway point operating device—Joest and Hansen.
3,902 Struts for bogies for railway vehicles—Leeds Forge Company and Sharp.
6,915 Brake-operating gear—Van der Straeten.

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ECONOMICS OF ELECTRIC TRACTION.

The appended paper, bearing the above title, was one of the papers set in the examination for railway students during the past session at the London School of Economics. Not more than ten of the twelve questions were to be attempted.

1. State the principal physical characteristics or facts that have led to the adoption of electric traction and their economic effect.
2. What relations must be satisfied between the motor equipment, the car (or train) weight and speed required by the traffic conditions, and the line on which it has to operate? What physical condition limits the power which can be utilised on a given vehicle?
3. Show how a schedule speed over a given line section is convertible into a speed time diagram, and how the latter is utilised in the choice of a motor equipment. What other information than the items mentioned is necessary? Which section of the line should be taken for the speed time diagram?
4. What are the principal advantages of the multiple unit system of electric motor equipment? What do you understand by "series characteristic" and "shunt characteristic" respectively?
5. Under what conditions do gradients increase the expenditure of energy in the running of a given service? How do they affect the amount of power equipment necessary? How do they effect the choice of equipment as between "series" and "shunt" characteristic motors?
6. State the principal elements affecting the cost of working a given service at different speeds, and the criterion for the most economical speed at which a given service should be run. How does the frequency of stops affect this?
7. In what ways do the terminal and station working affect the running costs and earning capacity of a service? How does electric traction especially facilitate such working?
8. State what conditions tend to the adoption of automatic signalling, and why it is then superior to manual signalling.
9. The supply of electrical energy to a line may be carried out by generation at the pressure at which it is supplied to the vehicles; by generation at high pressure, with conversion to low pressure for supply to the vehicles; and by generation at high pressure which is supplied to the vehicles without change of pressure or form. State the conditions favouring each of these alternatives.
10. How can the best commercial traffic results be obtained from a tramway; and what is the general criterion? Is there any general difference between tramways and railways in this respect, and when does such difference become least marked?
11. What are the main elements to consider in making up a traffic estimate for (*a*) a town tramway; (*b*) a steam suburban railway which it is proposed to electrify; (*c*) a proposed electric suburban railway?
12. How does the existence of mixed traffic—suburban, main line passenger and goods—affect the choice of a system of electrification? Are there any other important elements to consider?

Colonial and Foreign Tramways Traffic Returns.

NAME OF COMPANY.	1914. WEEKS ENDED.					1915. WEEKS ENDED.					AGGREGATE.		
	Oct. 3.	Oct. 10.	Oct. 17.	Oct. 24.	Oct. 31.	Oct. 2.	Oct. 9.	Oct. 16.	Oct. 23.	Oct. 30.	Wks.	1915.	Increase or Decrease.
	£	£	£	£	£	£	£	£	£	£		£	£
Anglo-Argentine	49.254	53.843	52.353	49.213	48.033	49.939	53.082	53.405	50.754	49.043	43	2.186.099	−136.897
Auckland	20.993	(28 days)	...	...	...	20.266	(28 days)	...	...	...	13	62.295	− 3,055
Burma ... ... Rs.	4.089	3.304	3.524	3.432	...	3.427	3.889	4.146	4.613	...	...	47.991	+ 2.754
Calcutta ... ... Rs.	58,053	53.243	54.516	55.458	56.175	66.365	69.889	70.697	59.650	56.550	43	2.839,679	− 59.033
Hong Kong ... ... $	10.694	10.934	10.464	10.030	9.767	10.506	12.289	11.227	10.265	10.804	44	483.878	− 16.634
Madras .. .. Rs.	24,354	(14 days	24.042	(14 days)	22.246	28.304	(14 days)	29.529	(14 days)	31.293	42	588.883	+ 25.346

Companies Issuing Monthly Statements.

	1914.						1915.						Wks.	AGGREGATE.	
	April.	May.	June.	July.	August.	Sept.	April.	May.	June.	July.	August.	Sept.		1915.	+ or −.
	£	£	£	£	£	£	£	£	£	£	£	£		£	£
Brazilian Street Mlrs.	...	...	...	...	...	...	...	...	...	...	...	...	...	—	—
BrazilianTraction Mlrs	5,941,220	6,180,830	6,188,900	6,462,860	6166100	6096940	6,333,460	6,670,110	6,591,940	6,703,000	6576000	6494000	39	6,494,000	+2,287,022
Brisbane	28,610	29,860	28,590	29,660	33,172	28,031	29,890	31,780	29,880	31,150	35,064	30,360	39	275,074	+ 15,216
British Columbia $	698,508	678,314	660,383	690,023	674,812	650,516	540,861	512,568	498,093	510,723	507,126	517,022	13	1,534,871	− 480,480
Buenos Aires Pt. & C.	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Buenos Ayres Lacroze	...	...	...	43,328	40,508	40,333	...	...	...	41,460	41,468	39,355	13	122,283	− 1,886
Cape Town	...	...	...	...	...	...	...	...	...	13,960	...	13,310	—	—	—
Carthagena& Herrerias	2,069	2,202	1,405	2,416	2,758	2,175	1,496	1,931	2,059	2,157	1,523	1,252	39	15,580	− 5,565
Cordoba	13,406	14,667	13,974	14,165	13,371	...	13,607	14,458	14,091	14,373	14,157	...	22	70,724	+ 1,141
East India	1,837	1,885	1,966	2,045	2,112	1,980	...	2,119	2,194	2,231	2,266	2,054	9	4,320	+ 228
Kalgoorlie	2,820	3,025	2,692	2,552	3,042	...	2,841	3,269	2,707	2,775	3,165	...	35	22,119	+ 1,003
La Plata	4,716	4,727	4,560	4,358	4,060	3,598	4,269	4,489	3,876	4,055	4,165	3,894	39	37,886	− 3,966
Lima	34,153	33,215	33,499	34,627	29,898	28,717	31,615	31,700	31,650	33,344	32,011	30,543	39	288,258	− 12,165
Manila ... ... $	134,300	138,600	132,500	133,900	128,500	116,300	117,450	120,475	116,875	123,750	126,650	123,946	39	1,100,024	− 114,056
Melbourne	...	...	...	...	...	...	...	...	...	63,432	...	...	—	—	—
Mexico ... ... $	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Montevideo	29,650	29,016	28,049	26,417	26,075	25,226	26,786	27,771	24,266	25,161	26,493	25,070	47	303,417	− 31,548
Port Elizabeth ..	...	...	...	...	...	...	...	...	...	3,362	...	2,927	—	—	—
Puebla ... ... $	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Rangoon	5,367	5,323	4,997	4,975	4,629	4,119	4,964	4,887	4,997	4,629	4,510	4,445	39	43,329	− 2,728
Toronto ... ... $	830,299	871,733	861,938	866,221	850,639	879,321	795,816	795,262	787,558	773,013	762,627	804,902	39	7,150,605	− 471,502
Winnipeg ... $	337,414	337,664	335,012	346,630	322,762	310,996	264,856	263,302	255,549	248,022	251,189	261,982	39	2,513,449	− 558,491

(*Continued on page 408*)

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TRAFFIC RETURNS—*continued.*

Tramways and Omnibus Undertakings in the United Kingdom.

NAME OF COMPANY OR CORPORATION.	1914. WEEKS ENDED.					1915. WEEKS ENDED					AGGREGATE.		
	Oct. 3	Oct. 10	Oct. 17	Oct. 24	Oct. 31	Oct. 2	Oct. 9	Oct. 16	Oct. 23	Oct. 30	Wks.	1915.	Increase or Decrease.
	£	£	£	£	£	£	£	£	£	£		£	£
Aberdeen Corporation	1,617	1,563	1,452	1,465	1,474	1,767	1,729	1,672	1,674	1,619	21	39,116	+ 1,870
Accrington Corporation	666	451	465	454	451	584	484	540	545	526	30	17,063	+ 105
Ayr Corporation	288	252	238	232	226	363	284	276	254	245	24	10,882	+ 575
Bath Electric	*	...	...	...	...	...	...	...	...	...	—	—	—
Birkenhead Corporation	1,249	1,210	1,202	1,178	1,161	1,356	1,355	1,408	1,282	1,314	30½	42,545	+ 3,324
Birmingham Corporation	11,793	11,702	11,775	11,772	11,894	15,204	15,395	15,342	15,180	15,019	31	429,210	+ 54,840
Blackburn Corporation	1,276	1,179	1,114	1,122	1,029	1,248	1,135	1,188	1,173	1,087	31	41,135	– 471
Blackpool and Fleetwood	857	580	489	411	373	998	665	496	393	357	43	36,295	– 260
Blackpool Corporation	1,738	1,004	870	710	618	2,188	1,295	998	822	703	31	62,957	+ 1,328
Bolton Corporation	2,527	2,482	2,464	2,341	2,456	2,545	2,692	2,697	2,580	2,581	31	83,616	– 2,296
Bournemouth Corporation ...	1,748	1,631	1,663	1,616	1,640	1,979	1,995	1,977	1,723	1,771	31	69,785	+ 3,599
Bradford Corporation	5,877	5,995	6,561	5,817	6,017	6,393	6,267	6,616	6,149	5,914	30	203,218	+ 8,330
Brighton Corporation	1,087	1,018	927	916	918	1,101	1,099	1,067	956	940	30½	36,870	+ 52
Bristol	8,633	8,155	8,030	7,681	8,139	9,702	9,096	9,282	9,483	8,910	43½	412,573	+ 38,565
Burnley Corporation	1,443	1,410	1,282	1,328	1,225	1,592	1,564	1,615	1,554	1,560	31	50,080	+ 265
Burton-on-Trent Corporation ...	288	309	280	284	278	286	317	274	263	262	31	9,012	– 391
Bury Corporation	1,250	1,262	1,224	1,361	1,176	1,329	1,332	1,313	1,256	1,291	30½	42,928	– 750
Cardiff Corporation	2,629	2,575	2,491	2,513	2,453	2,717	2,667	2,653	2,540	...	29	81,469	– 2,969
Chatham and District	1,153	1,069	1,027	1,269	1,007	1,241	1,221	1,220	1,417	1,061	43	50,769	+ 9,183
Chesterfield Corporation	249	244	245	244	241	268	266	275	265	258	30	8,291	– 62
Colne Corporation...	227	255	207	194	196	247	254	258	253	278	—	—	—
Cork Electric	519	523	478	480	465	503	542	522	500	487	43	21,839	+ 28
Croydon Corporation	1,674	1,642	1,565	1,550	1,536	1,782	1,754	1,926	1,843	1,604	31	57,843	+ 4,166
Darlington Corporation	265	261	252	248	250	266	267	272	266	266	30½	8,311	+ 114
Derby Corporation	969	949	951	952	934	1,014	1,016	1,052	992	975	30½	32,605	+ 844
Dover Corporation	271	263	275	248	247	309	306	305	287	269	30	9,996	+ 1,801
Dublin and Lucan	155	139	127	129	119	165	151	149	136	134	17	2,831	+ 97
Dublin United	6,151	5,822	5,701	5,763	5,408	6,265	6,077	6,241	6,062	5,833	43	264,876	+ 10,458
Dundee City	1,285	1,341	1,197	1,226	1,221	1,346	1,449	1,395	1,344	1,320	23½	32,742	+ 1,697
East Ham Corporation	1,217	1,216	1,199	1,186	1,195	1,274	1,246	1,299	1,265	1,238	30½	40,584	+ 5,651
Exeter Corporation	361	350	331	332	315	368	363	370	347	340	30	12,029	+ 705
Gearless Motor Buses	*	...	...	...	...	...	...	...	...	...	—	—	—
Glasgow Corporation	20,577	20,632	20,331	20,411	20,006	23,054	22,359	22,551	21,965	21,866	22	476,636	+ 36,067
Glasgow Subway Railway ...	...	...	992	1,010	984	...	...	1,065	1,096	1,182	43	45,140	+ 778
Glossop (Urban Elec. Supply Co.)...	107	99	102	100	101	128	135	133	128	127	44	5,534	+ 124
Halifax Corporation	2,048	2,097	2,141	2,083	2,008	2,349	2,150	2,133	2,167	2,037	30	69,690	+ 897
Hastings and District	1,084	989	875	856	837	1,032	984	956	874	739	43	63,438	– 59
Huddersfield Corporation	2,303	2,437	2,379	2,335	2,287	2,822	2,558	2,526	2,513	2,450	30	83,764	+ 12,562
Hull Corporation	3,025	3,360	3,739	2,912	2,935	3,067	3,064	3,078	3,042	2,982	30	96,771	– 3,613
Ilford U.D. Council	590	568	551	562	562	627	620	608	603	582	30	20,246	+ 2,877
Ilkeston Corporation	121	122	115	150	118	133	136	129	156	...	30	4,114	+ 106
Ipswich Corporation	435	413	396	397	407	540	521	517	504	490	29	17,541	+ 2,700
Isle of Thanet	601	487	405	372	360	372	341	330	287	246	4	1,319	– 546
Kilmarnock Corporation	159	150	148	146	152	163	164	162	167	163	24	4,175	+ 127
Lanarkshire	1,849	1,787	1,782	1,931	1,827	2,426	2,101	2,152	2,318	2,001	43	85,324	+ 3,863
Lancashire United	1,586	1,517	1,543	1,526	1,473	1,788	1,705	1,734	1,718	1,617	43	75,561	+ 4,682
Leeds City	8,018	7,985	8,016	7,895	7,838	8,998	8,821	8,817	8,666	8,314	31	277,502	+ 21,631
Leicester Corporation	2,670	2,939	2,726	2,706	2,690	2,978	3,124	3,252	3,107	3,082	44	131,796	+ 7,213
Leith Corporation...	676	688	657	676	689	786	765	775	742	749	24	19,002	+ 1,156
Leyton U. D. Council	1,341	1,343	1,328	1,323	1,321	1,606	1,561	1,584	1,512	1,506	30	50,183	+ 7,147
Liverpool Corporation	12,905	12,579	12,570	12,812	12,408	13,492	13,544	13,665	13,248	12,963	43	579,381	+ 7,658
Llandudno and Colwyn Bay ...	265	226	201	177	160	351	303	276	250	214	48	16,535	+ 1,637
London County Council	*	...	...	...	...	...	...	...	...	...	—	—	—
London General Omnibus... ...	*	...	...	...	...	...	...	...	...	...	—	—	—
London United	*	...	...	...	...	...	...	...	...	...	—	—	—
Lowestoft Corporation	193	177	191	183	187	136	133	122	129	127	4½	556	– 272
Maidstone Corporation	254	216	215	202	179	265	253	227	215	182	30	6,979	+ 157
Manchester Corporation	17,021	16,904	16,634	16,448	16,417	17,629	18,304	18,307	17,892	17,631	30	553,310	+ 18,206
Metropolitan Electric Tramways ...	*	...	...	...	...	...	...	...	...	...	—	—	—
National Steam Car	*	...	...	...	...	...	...	...	...	...	—	—	—
Nelson Corporation	177	144	144	133	163	201	200	182	179	194	30½	6,095	+ 66
Newcastle-on-Tyne Corporation ...	5,732	5,703	5,571	5,692	5,683	6,542	6,509	6,508	6,365	6,388	30	195,354	+ 27,473
Newport (Mon.) Corporation ...	782	778	748	764	756	831	813	822	795	784	31	26,047	+ 162
New St. Helens and District ...	1,002	952	996	989	889	1,037	961	982	953	897	17	19,159	+ 2,159
Northampton Corporation... ...	621	601	584	562	603	707	675	686	659	651	30	22,842	+ 4,463
Nottingham Corporation	3,460	3,973	3,280	3,294	3,233	3,682	3,725	3,773	3,689	3,561	30	114,428	+ 7,734
Oldham Corporation	1,949	1,953	1,926	1,883	...	2,169	2,373	2,352	2,240	...	31	72,031	+ 2,489
Portsmouth Corporation	2,447	2,347	2,101	2,195	1,987	2,372	2,398	2,361	2,220	2,054	31	80,811	—
Preston Corporation	885	873	853	838	837	962	962	954	956	909	30	29,335	+ 645
Provincial...	2,202	2,098	2,007	2,066	1,884	2,172	2,244	2,246	2,105	1,996	4½	9,314	+ 622
Reading Corporation	674	688	667	649	654	781	767	768	739	756	30	24,457	+ 2,490
Rhondda Tramways	1,259	1,213	1,208	1,184	1,142	1,253	1,263	1,258	1,250	1,177	43	51,025	– 2,355
Rochdale Corporation	1,507	1,459	1,478	1,440	1,403	1,619	1,713	1,710	1,646	1,586	30½	53,684	+ 2,276
Rotherham Corporation	1,130	1,109	1,075	952	1,084	1,179	1,191	1,167	1,176	1,274	31	36,341	+ 3,738
Salford Corporation	4,807	4,799	4,678	4,556	4,727	5,104	5,302	5,282	5,043	5,054	30½	162,684	+ 6,162
Sheffield Corporation	7,607	7,682	7,541	7,473	7,615	9,129	9,196	9,331	9,099	9,008	31½	280,973	+ 37,040
Southampton Corporation... ...	1,272	1,258	1,193	1,148	1,146	1,547	1,556	1,550	1,469	1,426	30	46,354	+ 4,610
Southend-on-Sea Corporation ...	954	846	736	737	724	809	723	699	670	614	30	27,368	– 7,456
South Metropolitan Tramways ...	*	...	...	...	...	...	...	...	...	...	—	—	—
South Shields Corporation ...	700	698	680	659	695	790	821	775	765	761	30½	24,924	+ 932
Sunderland Corporation	1,324	1,346	1,291	1,334	1,345	1,469	1,479	1,502	1,425	1,427	31	46,599	– 134
Sunderland District	549	918	546	538	567	595	564	1,034	585	574	52	30,120	– 462
Swindon Corporation	179	180	174	172	179	209	198	195	191	172	30	6,133	+ 616
Torquay Tramways	521	494	460	443	413	561	545	510	475	427	43	24,413	– 513
Tramways (M.E.T.) Omnibus Co. ...	*	...	...	...	...	...	...	...	...	...	—	—	—
Tyneside Tramways and Tramroads	709	683	669	654	630	619	593	592	574	539	17	10,951	– 503
Wallasey Corporation	1,148	1,119	1,078	1,088	1,037	1,187	1,213	1,190	1,118	1,093	30½	40,892	+ 301
Walsall Corporation	636	616	630	630	626	775	802	798	774	767	44	32,290	+ 4,797
Walthamstow U.D. Council ...	786	760	720	728	717	813	811	805	770	711	31	29,055	+ 3,323
Warrington Corporation	436	424	413	417	415	466	464	470	457	448	30	13,835	+ 602
West Ham Corporation	2,781	2,765	2,728	2,698	2,734	3,081	3,035	3,085	2,964	2,881	30	95,563	+ 9,271
Wigan Corporation	1,401	1,415	1,437	1,375	1,456	1,548	1,554	1,597	1,586	1,682	30	46,739	+ 1,940
Wolverhampton Corporation ...	1,000	1,008	958	985	1,020	1,106	1,124	1,081	1,074	1,106	31	34,886	+ 1,671
Yorkshire (West Riding)	1,472	1,464	1,370	1,322	1,378	1,579	1,540	1,579	1,436	1,398	44	69,704	+ 5,748

* TRAFFIC RETURNS SUSPENDED.

Owing to the European war, the Government have taken over the railways of Great Britain as from August 4, 1914, and the issue of traffic returns has been suspended. Consequently the traffic returns of the electric railways which usually appear on this page cannot be given.

The Publication of the Traffic Returns of the Tramways marked with an asterisk in the above table have also been suspended during the war.

TRAMWAY DIRECTORIES.

A useful feature of this issue is the directory of electric railways and electric tramways which will be found among the advertising pages. This directory contains the names of the chief officals and the principal particulars relating to each undertaking.

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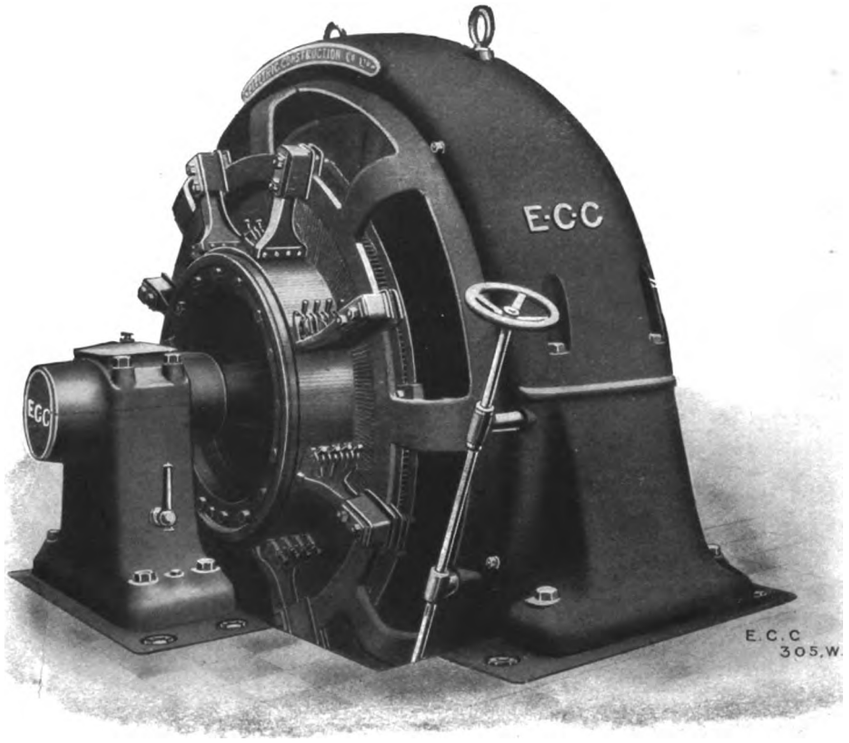

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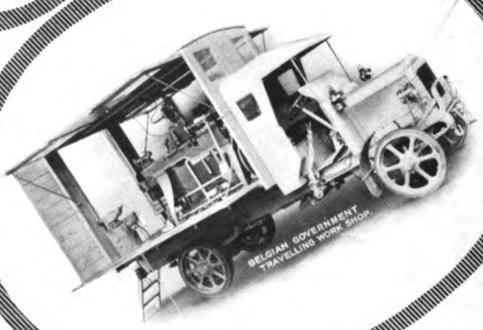

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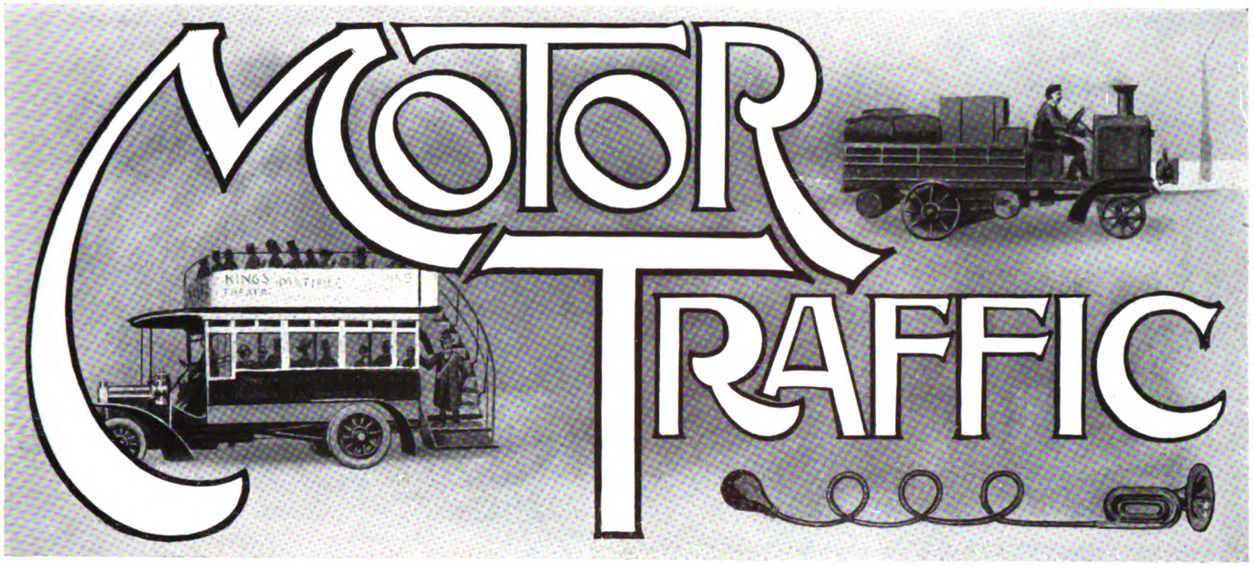

Municipal or private traction undertakings that need an increased number of omnibuses to meet the traffic created by war work, may be advised to lose no time in placing their orders. If the vehicles are required for the immediate use of passengers who are engaged at factories turning out goods for the Government, it is probable that the orders would come in the category under which the leading makers are allowed to supply their vehicles. In any case an order given now to a British firm will ensure delivery at the earliest possible time, which is a matter of importance in view of the expectation that a great demand for petrol vehicles will arise later on. One advantage of the self-contained fraction unit is that its cost is comparatively light, thus enabling payment to be made from revenue or from reserve funds in the event of sanction not being obtained for a loan. There are also manufacturers who, in return for the present rate of interest, do not object to accept payment by instalments from such safe customers as the owners of transport undertakings. Without counting the business done in foreign commercial vehicles in the early days of the war, when some means had to be adopted for making good the thousands of motor conveyances and horses required by the Government, this country may congratulate itself upon possessing far greater resources in motor transport than are available for the enemy. This is proved by the fact that while London streets are full of omnibuses and cabs, Berlin has been swept clear of both, while since March 15 last the driving of private automobiles has been prohibited throughout Germany. Continual augmentation of our motor vehicles is going on at home and in the war area, an eloquent proof of the latter being afforded by the present opening of the motor transport corps to learners. Following the expedient adopted last year at the periods when the railways were occupied solely by Government traffic, many business firms have come to rely upon motor transport. For the conveyance of munition workers, omnibuses have proved invaluable, notably at such places as Sheffield and Manchester. If more of these vehicles had been available they could have been utilised in a manner profitable to both their owners and to the nation. The Sheffield Tramways Department are now running 21 omnibuses, an increase of seven upon the average number in service last year, and it is significant that the general manager informs us that there is work for at least 45 vehicles in carrying out the department's policy of extending and feeding tramway routes.

The exact position as regards the import duties on foreign motor vehicles is still somewhat indistinct. That vehicles constructed or adapted solely for the carriage of goods or merchandise in the service of trade or industry are to be exempt is common knowledge. Various legal decisions seem to show that if a vehicle is capable of being adapted for use other than that mentioned above, it cannot claim exemption. Users are consequently left in some doubt as to what is to be done about the large number of light van chassis that are now being imported into, or assembled in, this country. Their components are in the main identical with those of touring cars of the same makes, which complicates the business still further. It would be impossible honestly to define such components as being not adaptable for use in a private motor car. Probably the type that is most concerned of all in this matter is the Ford, and the recent outburst of Mr. Henry Ford on the subject of the Franco-British Financial Commission may be taken to have alienated any sympathy or support which might otherwise have gone his way. At the present moment there is a strong feeling in some quarters that taxation of imported cars should be by weight rather than by declared value. We can well imagine that under existing circumstances, many people will be calculating with a view to ascertaining which of the two schemes would be most objectionable to Mr. Ford as a preliminary to deciding which they themselves are disposed to support.

* * * * * *

These are days during which people have to put up with many things that they do not like, and we must perforce reconcile ourselves to new taxes and to the fact that for the time being the Road Board will no longer continue its activities in the interests of motorists and other road users. When the first petrol tax was imposed by Mr. Lloyd George, it met with considerable opposition on the grounds that it was a tax upon industry. This opposition, however, was not unanimous, because it was felt in some quarters that, by the payment of the tax, the owner of an industrial or public service motor might be regarded as having purchased the right to use the roads in a reasonable manner. Why any such purchase should be necessary in order to secure such rights for the essential traffic of the country was never very clear, but the argument was sufficiently specious to weaken the case of those who objected on principle to a tax upon industry. Since the Road Board has been formed, the old complaints that heavy motors

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MOTOR TRAFFIC.

were damaging the roads and paid nothing towards their upkeep have not ceased. The fact that the products of the petrol tax went to a national fund and not into the pockets of local authorities frequently made these latter quite oblivious to the circumstance that the taxes were being paid at all. It is, of course, rather poor comfort for a municipality, charged with making good any damage that its municipal omnibus services may do to the roads, to know that they are at the same time paying into the national fund money which will probably be used to improve roads elsewhere. The tax on its original basis, and with the understanding that the money went to the Road Board, was never really fair in its application to motors owned by local authorities.

* * * * * *

Now we have a new set of conditions. The activities of the Road Board are in abeyance for the period of the war. The proceeds of the old petrol tax go to the general income of the country and not to any specific purpose. In other words, the only argument that ever justified in any degree this direct tax upon industry has been knocked on the head. Nevertheless, at the same time the industrial motor vehicle is picked out to make a still larger contribution to the national revenue. It is very difficult to see the fairness of this new tax, which falls upon one form of transport and tends to handicap it in competition with other forms. Quite rightly, the motive powers of railway trains and tramway cars are not taxed. Incidentally, this means that the steam lorry and tractor go free. Meanwhile, the petrol industrial vehicle is singled out for no obvious reason to contribute twice us much towards national revenue as it previously did towards the improvement of the roads upon which it runs. Without objection to high taxation, which we all realise is necessary, there are still grounds for objection to details of this taxation that are not equitable in their incidence, details that hit necessities rather than luxuries. The original proposal of the present Chancellor of the Exchequer was to increase the petrol tax by 3d. a gallon all round. This would mean 4½d. per gallon on industrial vehicles. When these first proposals were published, various motoring institutions considered the question, and submitted suggestions to the Chancellor. These suggestions appear to have been very half-hearted. They certainly helped towards the halving of the new tax, and there appears to be no reason to conclude that if the matter had been put before him clearly and forcibly the Chancellor would not have dispensed with this tax altogether. No one complains of the taxing of petrol used in private motor cars, but the taxing of the fuel of industry is quite another matter, and those who took upon themselves to approach the Chancellor ought certainly to have made this distinction of principle very clear.

SALFORD CORPORATION have appointed a committee for the purpose of making inquiry as to the present use made of the motor cars provided for municipal purposes, to take into consideration the desirability of forming rules and regulations for the future management and control of motor vehicles required for municipal purposes, and also the question of establishing a municipal garage.

FIFTY AMBULANCES LOST.—Fifty motor ambulance cars have been lost in course of transit from this country to France, the vessel being sunk by a submarine. Sympathisers with France are invited to send donations to the Hon. Secretary, French Relief Fund, 83, Pall Mall, S.W., to assist in replacing the vehicles.

LONDON TRAFFIC IN 1913.

SIR ALBERT STANLEY'S PAPER AT THE SAN FRANCISCO CONFERENCE.

Subjoined is an abstract of the paper on "London Traffic in 1913," presented at the International Engineering Congress at San Francisco, by the managing director of the allied traffic companies of London. Publication of the full text is deferred to a future issue. The author described the geographical conditions of London, the administrative county having an area of 112 square miles, and a population density of 60 persons to the acre. Beyond this was the outer suburban ring, with an area of 2,115 square miles, the population density being less than one person to the acre. The Underground Railways, which serve the central core of the city and county, had 180 stations, only 33 being outside the county. The main line or trunk railways, which serve the city and the outer suburban ring, had 574 stations. The terminals were detached, and, with the exception of Charing Cross, were not located at a really immediate traffic centre.

The tramways were practically excluded from the central area for reasons based on the narrow thoroughfares, but in the county 145 miles of tramway were operated. Outside of the county there were 201 miles of tramway, which had 2,780 cars. None of these lines entered the city, and the inter-urban railway was unknown. The motor-omnibus had spread a network of routes all over the area covered by Greater London and to parts beyond. The number of omnibuses owned approximated 3,500.

The consequences of the unco-ordinated character of the problems of the traffic were seen in the isolation and lack of correlation between the urban and trunk line railway systems, the conflic between the tramways and the motor-omnibuses, and the exposed position of the latter, together with the conditions that would be attached to a franchise if one was obtained for them. In order to solve these problems the Underground Electric Company of London had undertaken to bring a number of the different facilities under a single control, and to-day it was responsible for the operation of 61 route-miles of electric urban railway, 123 route-miles of tramway, and practically all the motor-omnibuses.

Traffic statistics for the year 1913 showed that the passengers were divided almost equally between the railways, tramways, and motor omnibuses, the average number of journeys per head of the population being 271 per annum. There was an extreme fluctuation of traffic in the course of the day, which was accentuated because of workmen's tickets at a reduced fare on the railways and tramways, these giving a morning peak of extraordinary severity which was escaped altogether by the omnibuses. Whilst the County Council Tramways showed an increase of only 1·3 per cent. in the number of passengers, the omnibus passengers increased at the rate of 107 per cent.

The motor omnibus fell in with the moving stream of traffic, and did not monopolise the centre of the roadway. It was a small traffic unit, less adapted to the carriage of heavy peak loads than to the carriage of the constant pick-up traffic of the streets. But experience showed that a quick succession of small units proved to be very efficient. The average load of a tramcar, with 74 seats, was 10¾ passengers, and of a motor omnibus, with 34 seats, 8 passengers. The relative efficiency of the omnibus, measured in percentage of seats offered, was therefore almost twice as great as that of the tramcar. The omnibus, escaping from the artificial lines which formed the boundaries of districts, was able to consider a route more purely from a traffic point of view. On roads with foundations made sufficiently strong to carry the weight of an omnibus, and with a rigid surface such as that given by wood blocks or the hardest asphaltic macadam, the wear occasioned was less than that caused by other types of vehicle.

In dealing with fares, Sir Albert said there was no "fares system" in London, and the problem for the reformer was an intricate one. For the heavy capitalisation of the various tractive enterprises, and their low returns, the only remedy was expansion of traffic, and to this end advertising had proved generally successful. The solution of the London problem could never be conclusive until a spirit of co-ordination and co-operation was introduced.

WAR OFFICE CONTRACTS.—The Daimler Company, Limited, of Coventry, and Wolseley Motors, Limited, have received contracts for the supply of motor chassis and motor cars respectively to the War Office.

ELECTRIC CARS IN ROME.—The war has not produced any diminution of the large number of battery cars in use in the Italian capital. To their owners these vehicles have the advantage of being useless for Army work.

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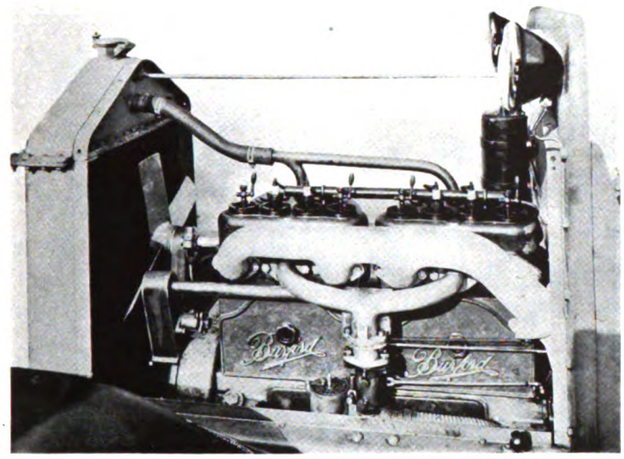
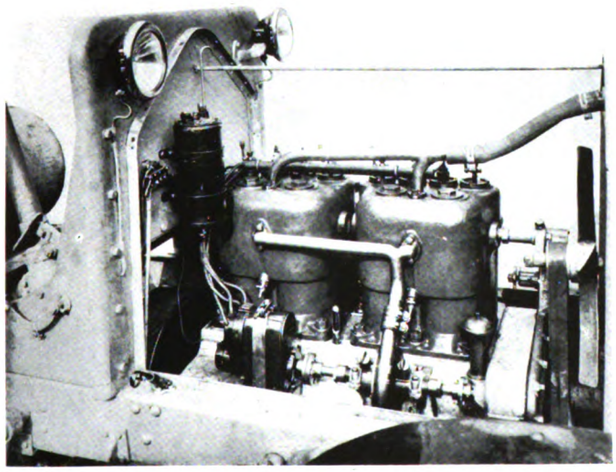
MOTOR TRAFFIC.

BURFORD 4-TON WORM-DRIVEN MODEL.

The motor trade is pre-eminently one in which a name counts. In the commercial and industrial section, which is undoubtedly the most important from a national point of view, the name of the company stands for the excellence of their vehicles. One of the pioneers of the industry is Mr. H. G. Burford, who has been associated with the Milnes-Daimler and Humber companies. For an engineer of his experience it was only necessary to give his name to machines to the design of which he had turned his attention to lay the foundation of a flourishing business. This step was taken during the first half of the year 1914, when was placed on the market a 2-ton chassis with three speeds and reverse, and a number of excellent features that have won the approval of users.



Off-side View of Burford Engine.

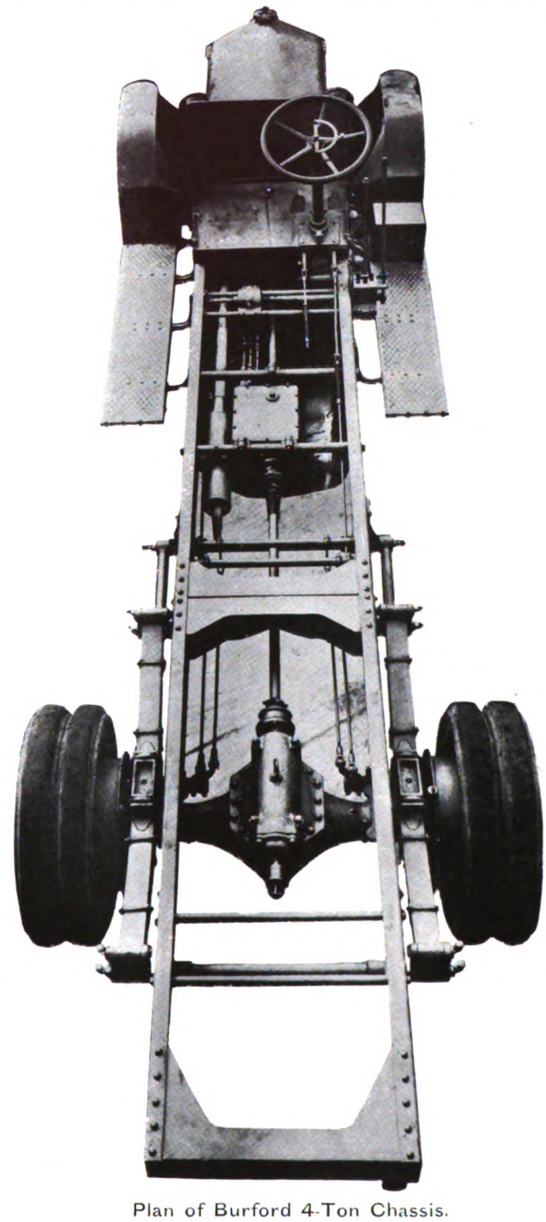


Engine and Magneto seen from Near Side.

This machine has been followed by one designed for a 4-ton load, and giving a number of improvements to fit it for its heavier task. These improvements are specially apparent in the greater capacity of the engine, the substitution of four speeds and reverse of the independent gear box, the increased strength of the frame and rear axle, and the provision of worm drive.

Apart from the work of the body builder, the completed commercial and public passenger motor vehicle is more and more coming to possess a distinctive appearance according to the artistic skill of the designers. That this is so with the Burford chassis can be gathered by a glance at the photographs accompanying this description of the machine, two showing the side elevation and plan and the other two affording complete views of the engine from both sides.

A brief description of the specification of the 4-ton model may be given. The engine is of $4\frac{1}{2}$ in. bore by $6\frac{3}{4}$ in. stroke, giving 45 H.P. at 1,200 revolutions. Chrome nickel steel is used for the crank shaft, and the bearings are lined with white metal. The "Zenith" carburetter has the usual attachments, and the ignition is by high tension magneto. Very thorough means have been provided for cooling, the circulation being effected by centrifugal pump, while the radiator is built up of improved gilled tubes of large capacity and very efficient. For lubrication there is a combination of the splash and pressure pump system. Ample storage for petrol is provided by a 25-gallon tank carried under the driver's seat. Ease of manipulation is given by the worm and sector steering and control, with right-hand drive, the change-speed lever having gate operation.



Plan of Burford 4-Ton Chassis.

The clutch has a wide leather-faced cone of large diameter, connected with the independent gear box by a double-jointed shaft. As already indicated, there are four speeds forward and the reverse, the final drive being by propeller shaft to the rear axle, which has worm and worm-wheel transmission. The braking is accomplished in a direct line to the rear wheels by two sets of brakes, both of very ample dimensions. The rear action is very substantial, being built

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MOTOR TRAFFIC.

with special care to carry the load, while the front axle is of drop forging "I" section, made from high carbon steel.

Inspection of the frame shows that strength has been attained. It is of channel steel, 7 in. deep, strongly braced and gussetted. The radius rods that connect the frame with the back axle below the springs are of special design and ample dimensions, fitted with bronze bushes for taking up all strain; they complete the appearance of great strength. Of very ample dimensions are the springs, those on the front axle being 3 in. wide and 43 in. long, the back axle springs being 3½ in. wide and 60½ in. in length.

The overall length of the chassis is 21 ft., the length behind the driver's seat 12 ft. 6 in., behind the driver's seat to the centre of the back axle 7 ft. 8 in., and from centre of the back axle to the end of the frame 4 ft. 10 in. The frame is 2 ft. 9 in. in width and 3 ft. high. The rubber tires are 38 in. by 5 in., single on the front and double on the rear wheel. The wheel width is 54 in. inside the rear wheels, and 6 ft. 2 in. over all outside the rear wheels.

Particulars as to price and delivery may be obtained from H. G. Burford and Company, 11, Waterloo Place, London, S.W.

A Motor Transport Appointment.—Lieutenant J. Austin Baker, commanding the A.S.C. Workshops, Heavy Armoured Cars, A.P.O., R.B., British Expeditionary Force, France, before joining the Army was on the traction department staff of the British Westinghouse Company, Manchester. He enlisted last January in the Army Service Corps as a lorry driver, was promoted sergeant and transferred as an assistant foreman fitter in the shops on July 25, 1915, and after giving proof of having served his apprenticeship in the Lancashire and Yorkshire Railway locomotive shops, University technical education, and positions held at home, he was promoted workshop officer with the rank of second lieutenant. The examination for a commission is very searching in the A.S.C., the candidate having to qualify in theory and practice of all types of road transport systems. One post that Lieutenant Baker has held will interest tramway men generally. It was that of assistant rolling stock superintendent, West Ham Corporation Tramways, first under Mr. H. E. Blain and afterwards under Mr. J. S. D. Moffett.

London Motor Traffic at Night.—Replying, on November 2, to a question regarding the speed of motor traffic within the Metropolitan area after dark, the Home Secretary has stated that it has been decided that the matter should be dealt with by making the fullest use of Section I. of the Motor Car Act, 1903. He had given special instructions to the metropolitan police stringently to enforce the regulation, and he had written to all the magistrates pointing out how the prevailing conditions of darkness ought to affect the mode of dealing with charges that may be brought before them by the police. Section I. made it an offence to drive a motor car "recklessly or negligently or at a speed or in a manner which is dangerous to the public, having regard to all the circumstances of the case."

Electric Vehicle Committee.—Sheffield Electric Supply Committee have contributed three guineas towards the expenses of the Electric Vehicle Committee of the Municipal Electrical Association.

TAXES ON IMPORTED CARS.

In the House of Commons on October 20 a motion by Sir A. Mond to exclude private pleasure motor cars from the scope of the new import duties was defeated by 169 votes to 34. Mr. Montagu, Secretary to the Treasury, said the duty was imposed because there were a large number of cheap cars being imported for purely luxury purposes. Mr. McKenna, Chancellor of the Exchequer, said the Government wished to discourage the motor industry on its luxury side. The taxes were intended as temporary until August 1 next, when they would have to be reintroduced as new taxes.

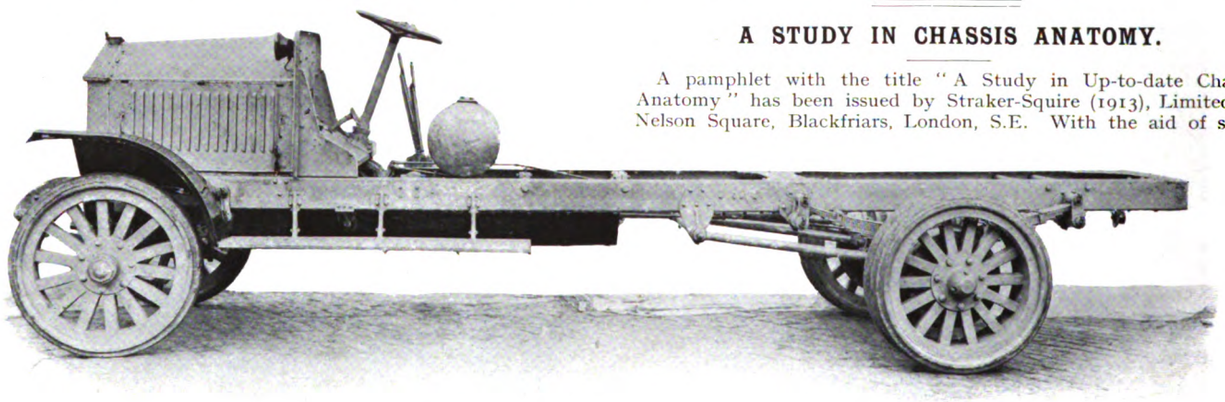
In reply to Mr. A. du Cros and other members, the Chancellor of the Exchequer said that it was not intended to apply the import tax to component parts of motor and other tires in any case where it was shown to the satisfaction of the Commissioners that the articles were not otherwise accessories or component parts of motor cars. Imported, partly-finished, wooden spokes, for use on taxable cars, would be liable to duty. Tire pumps were accessories to tires and would not be dutiable.

Sir A. Mond asked what method would be adopted to distinguish at the point of importation whether or not motor chassis and parts and accessories were going to be used exclusively for the conveyance of goods in the course of trade or husbandry. The hon. member also asked whether it was intended to stamp the 4,000 parts in a motor chassis in order to exempt them from duty.

The Chancellor of the Exchequer replied that he did not think it desirable to anticipate the debate in regard to those points, nor was he prepared to print them in the schedule to the Bill.

A STUDY IN CHASSIS ANATOMY.

A pamphlet with the title "A Study in Up-to-date Chassis Anatomy" has been issued by Straker-Squire (1913), Limited, of Nelson Square, Blackfriars, London, S.E. With the aid of some excellent illustrations it provides a useful guide in the study of the vital parts of this company's latest model suitable for public service and other heavy duty. The machine is designed to carry a load of four tons, excluding the body, and has a clear space behind the driver's seat of 12 ft. 3 in., with a wheel base of 14 ft. The views given show, separately, the complete chassis, the four-cylinder engine (4½ in. bore by 6 in. stroke), the four-speed spur gear box, and two views of the back axle—one in position in the chassis and the other with the worm drive dismantled. Care has been taken in the preparation of each of the views, so that the detail in each case has been well brought out and a good idea obtained of the design and workmanship of the part illustrated. Messrs. Straker and Squire have had some 15 years' experience of commercial vehicle work, and their present practice can be said to be the outcome of that experience.



Side Elevation of the Burford 4-Ton Model.

Prospective Order for Omnibuses.—In view of the probability of a large number of men being employed at new factories, Lancaster Tramways Committee have considered the question of tramway extensions, or the acquisition of motor omnibuses. The Board of Trade having informed them that powers for the running of omnibuses for munition workers might be obtained by way of Provisional Order, the committee have decided to ascertain what demand there is likely to be for omnibus facilities.

Motor Omnibuses in Melbourne.—The Victorian Government have decided to take over the Melbourne cable tramways in June next, although the municipality contend that the ownership should pass to them. A considerable time is likely to be spent in settling the dispute, and meanwhile the motor omnibus interests hope to increase their opportunities of service.

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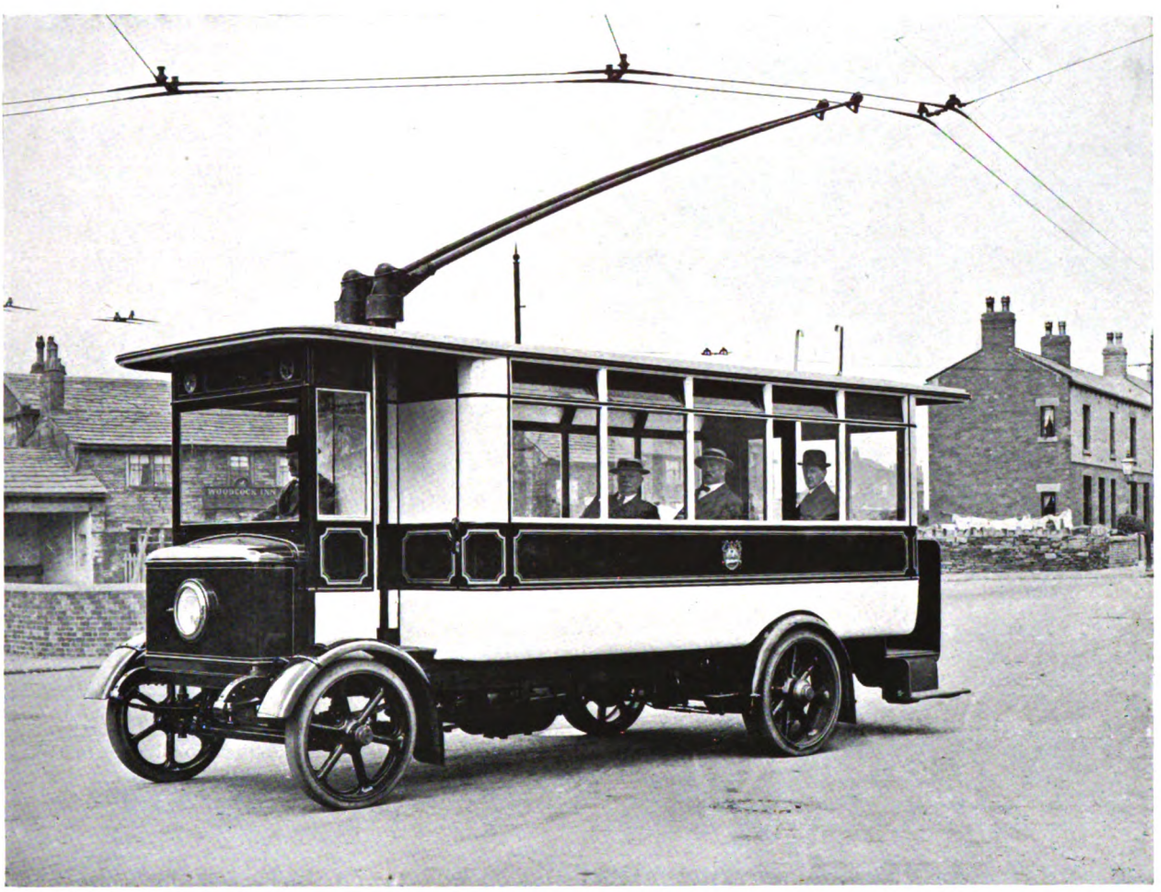
MOTOR TRAFFIC.

RAMSBOTTOM RAILLESS CARS.

A New Type of Vehicle built by the R.E.T. Construction Company, Ltd.

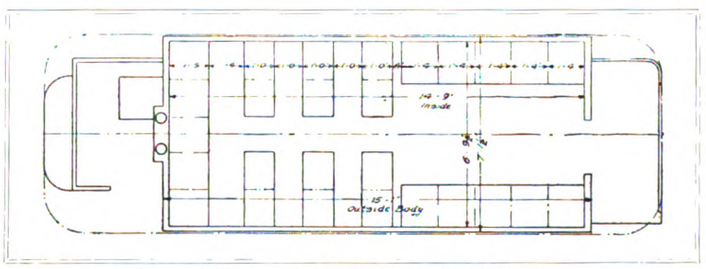
The new cars supplied to the Urban District Council of Ramsbottom are of the latest type of railless electric vehicle produced by the R.E.T. Construction Company, Limited, of London and Leeds. The company were also the contractors for the earlier vehicles with which the Council inaugurated their system of railless traction, and which have been illustrated in these pages.



New Railless Car for Ramsbottom District Council.

To the new vehicles a body is fitted that is specially designed to meet the conditions in the Ramsbottom district, and as will be seen by the illustrations the body is very roomy.

The drawing herewith indicates the special seating plan that has been adopted, and we are informed by the tramways manager (Mr. James Wild) that a very considerable saving in time is effected in handling the traffic, particularly during rush hours, owing to the easier methods of egress and ingress obtained by the new arrangement of the seats as compared with the original vehicles.



Plan of Improved Seating of "R.E.T." Cars.

In the former plan it was found that with transverse seats throughout the car, passengers seated nearest the gangway had to move to allow those occupying inside seats to pass out, and considerable inconvenience and crowding was occasioned when several passengers occupying inside seats wished to alight before the end of the journey was reached.

As arranged in the new vehicles the seats for half the length of the car nearest to the entrance are longitudinal, giving a wide space between the seat edges for the movement of passengers to the front end of the car, which is arranged with transverse seats. The whole of these arrangements have been very carefully planned with the assistance of Mr. Wild.

The chassis of these vehicles is the new type of "R.E.T." design, and it embodies all the improvements recently made. In the last three contracts executed by this firm the direct worm-driven rear axle, which has now been standardised, is employed. The motors are two in number, each 20 h.p., and are coupled independently, each to a section of the rear axle driving one wheel on either side.

As regards the construction of the body, the timber framework is of a comparatively light scantling and worked over a solid welded steel frame, which gives great strength with the necessary flexibility. The means adopted and the details of this construction are the result of extensive experiments made by the contractors during the past two or three years, and the result has justified the work put into the experiments. The R.E.T. Company have adopted as a standard method this composite form of construction, which gives a very strong and durable body of comparatively light weight, and the life of which will be considerably longer than the earlier types.

The lower panelling and the shaped corners are all formed in aluminium, and the finish and workmanship of these bodies have produced a very fine appearance.

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MOTOR TRAFFIC.

RUNNING COSTS OF DENNIS 5-TON TIPPING LORRY.

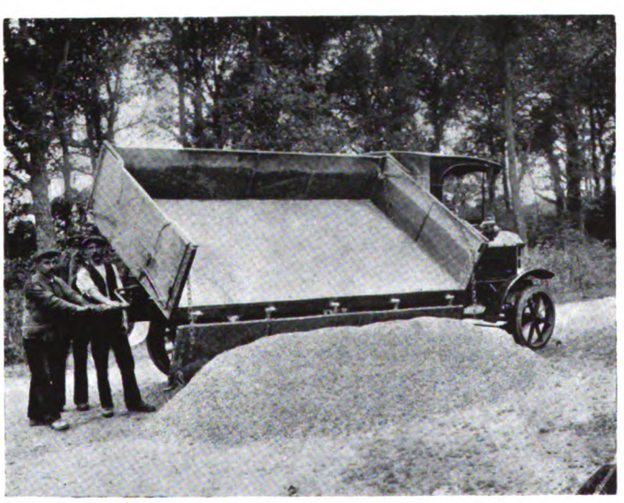
Some time ago Messrs. Dennis Brothers, Limited, of Onslow Works, Guildford, supplied to the Hambledon Rural District Council a 5-ton "Dennis" tipping lorry. The running costs

Tipping Load of Dennis Lorry.

appended have been given by Mr. S. Hasell, the surveyor to the Hambledon District Council. The figures cover a period of twelve months exactly, during which the mileage run was 11,184.

	£	s.	d.
Wages (Driver and Two Mates) ...	220	0	0
Petrol	116	12	2
Oil and Grease	15	19	3
Maintenance on a basis of 20s. per week	52	0	0
Insurance	16	0	0
Tires	73	16	0
Interest	36	0	0
Depreciation—15 per cent. on £660 ...	99	0	0
	£629	7	5

Mr. Hasell states that the cost of carrying out by horse hire the same work as that done by the tipping lorry, calculated by



Returning Body to Normal Position after Discharging Load.

actual tenders received at the time the vehicle was put into service, was £951 0s. 6d., so that the Council has actually made a saving of £321 13s. 1d. in the twelve months.

The vehicle from which Mr. Hasell obtained the excellent results given above is illustrated in the accompanying views.

WHERE OMNIBUSES ARE NEEDED.

In consequence of Bucklow Rural Council considering the motor omnibus service between Palatine Road tramway terminus and the village of Northenden to be inadequate, they have refused to renew the licenses to Manchester Corporation.

Mr. J. M. McElroy, general manager of the Tramways Department, had informed the Rural Council that at the outbreak of war the military authorities impressed all the motor omnibuses. The Corporation immediately tried to replace them. At last it was found possible to hire half a dozen from the London General Omnibus Company, but the day these were put on the road they were commandeered. A protest was made to the War Office on the ground that the motor 'buses of the General Omnibus Company were not then being taken from London, and the consequence was that the War Office stopped the impressment of the Manchester motor 'buses at that time. A little later, however, they were taken. The Tramways Committee managed to secure three omnibuses from the Daimler Company, and these have since been running. Orders were placed, too, for more, but the Treasury objected to the spending of the money.

It is stated that the Corporation have decided to provide a twenty-minute service. The Corporation have the right to run omnibuses as far as the Manchester boundary at the Mersey bridge, on the other side of which Northenden is situated.

A petition signed by 500 residents, protesting against the refusal of the license, was on October 27 presented to Bucklow Rural Council, together with a resolution passed by Northenden Parish Council, asking the authority to appoint a small committee to interview Manchester Tramways Committee and try to arrange for an improved service. As it was stated that an opposition petition was being organised, the Rural Council decided to hold an inquiry to ascertain the real wishes of the people.

The Birmingham and Midland Omnibus Company in November last ordered thirty-eight motor omnibuses from the manufacturers, and although delivery was promised before Easter, only eight had been received up to the end of September. The company have informed Broomsgrove Urban Council that as further vehicles became available they would be able to lessen the overcrowding on the Worcester, Malvern, and Broomsgrove omnibuses. The company asked the Council to renew the licenses of ten omnibuses, twelve drivers, and twelve conductors for twelve months, but the Council granted the renewals only to December 25.

Walsall Corporation, in view of the urgent need of travelling facilities for the colliery districts, have asked the War Office, Admiralty, and Ministry of Munitions to allow three Tilling-Stevens motor omnibuses to be delivered to them.

OMNIBUS TRAFFIC IN WORCESTERSHIRE.

In his annual report for 1914, Mr. C. F. Gettings, County Surveyor for Worcestershire, records that "There are now motor-omnibus services running over 192 miles of main roads in the county, the whole of which have been put into operation since September, 1912. The motor omnibus service is used by a large section of the community, which has been the means of opening up a number of villages, and in some cases enhancing the value of property, but I fear that the convenience in regard to the cost of the upkeep of the roads is not generally appreciated. In many cases the expense is not restricted to surface damage, as additional expense is necessitated in widening and strengthening roads which hitherto have been sufficient for the ordinary slow-moving traffic of the district. It is generally admitted that motor traffic will most probably increase, and that the various users of the road must be asked to contribute their fair proportion towards the cost of upkeep. Last year we anticipated that a scheme of classification would be agreed upon, and that further assistance would be forthcoming from Exchequer funds. Unfortunately, owing to the war, this scheme has been held up indefinitely, and although it is generally agreed that at an opportune time a scheme will have to be formulated, meantime the whole of the funds required for ordinary maintenance will have to be provided by the county."

Battery-driven Tower Wagon for Southampton.—After considering a report by the general manager, Mr. W. T. Robson, on the respective merits of the petrol and electric tower wagons which had been tendered for, Southampton Tramways Committee recommended that a battery-driven vehicle be purchased, together with a motor generator. The latter will be used for purposes additional to the charging of the batteries. The Council have adopted the recommendation.

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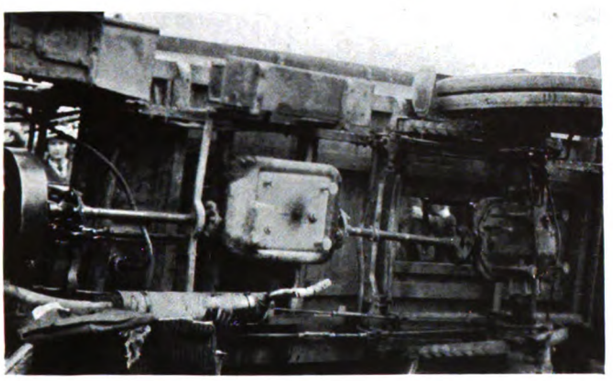
MOTOR TRAFFIC.

BRIGHOUSE OMNIBUS MISHAP.

Three persons were killed and 21 injured as the result of an accident to a motor omnibus on October 16 near Brighouse. The vehicle, built to carry 30 passengers, was owned by the Heavy Woollen District Tramways Company, and it was in service between Morley and Brighouse, *via* Cleckheaton. There were 29 persons on it at the time of the accident, which occurred about 10 p.m. on the hill known as Clifton Common, where the gradient is about one in sixteen and about half a mile long. On arrival at the summit the driver endeavoured to stop to allow passengers to alight, but neither the hand brake nor the foot brake would act, and the vehicle began to gather speed forward down the hill. The conductor failed in an effort to sprag a rear wheel, and after running a considerable distance, the omnibus collided with a telegraph pole. One of the rear wheels was wrenched off, and it ran a considerable distance down the hill, knocking down a girl, who sustained a fracture of the leg. The omnibus overturned, one side of the body being completely wrecked.

At the coroner's inquest the driver said he usually descended the hill with the gear at top speed. He admitted it would be better to use the low speed gear, but said that on this occasion when he got over the top of the hill he could not change the gear.



Motor Omnibus Overturned at Brighouse.

The foreman of the company's repair shop gave evidence of remedying defects complained of by the driver on four occasions during October. On the morning of the accident the brakes were tested. He examined the omnibus after the mishap and found the brakes in good condition, but the locking nut of the offside wheel had been pulled off and its thread had gone. He had never known the thread of a nut to be so stripped. It might have been caused by the sudden turning at the same time as the vehicle caught some obstruction in the road.

Mr. W. A. Cocking, engineer to the British Electric Federation, gave similar evidence of the result of his examination of the chassis, and said there was no better system of locking than that used on this wheel.

Mr. J. H. Harper, of Leeds, the Yorkshire manager for the Daimler Company, said he found the brake mechanism intact. A safety device prevented the lock nut of the wheel working itself loose; it could only have come off through the thread being stripped. The lock nut was of mild steel in order that a good fit might be obtained without the nut being made very difficult to get off. His theory was that the thread of the nut had been sheared through an excessive side strain, caused by a swerve round a corner or an obstruction. He had never had experience of a similar accident, and so unusual was the case that his firm had had the vehicle examined by their consulting engineer. The latter had now reported, and was exactly of his opinion.

In returning a verdict of accidental death, the jury recommended that the omnibuses should stop at a certain point; that an exit for passengers should be at the back of the omnibus, as the jury considered alighting from the front even at ordinary times to be dangerous; and that the seats up the middle of the omnibus should be done away with.

The Coroner said he thought drivers should be instructed to have their engines at low speed when descending this hill, so that the engine might act as a brake.

The company's solicitor remarked that in regard to a door at the back of the omnibus there were arguments both ways.

MOTOR VEHICLES FOR MUNICIPALITIES.

Halifax Council have agreed to purchase a motor ambulance.

Johannesburg Council have purchased a new motor car for the use of the Mayor.

Tiverton Council's surveyor has recommended the purchase of a tractor and trucks.

Glasgow Cleansing Committee are placing further orders for motor sweeping machines.

Widnes Council have placed a second Tilling-Stevens petrol electric omnibus in service.

Purley Council have agreed to provide a motor cycle for one of their sanitary inspectors.

Todmorden Council have purchased a motor car for the use of the Corporation departments.

Plymouth Council are urged by the medical officer in his annual report to provide a motor ambulance.

Rotherham Council have ordered three motor omnibuses from the Daimler Motor Company, Limited, Coventry.

Metropolitan Asylums Board recently invited tenders for the supply of twelve chassis for ambulance bodies.

Harrogate Council have purchased a motor cycle and sidecar for the use of the water department at a cost of £50.

Sheffield Water Committee have obtained a Ford motor ambulance for use in connection with the Emden Valley works.

Napier (N.Z.) Council propose to purchase two motor fire engines with equipment and a garage for the vehicles, at a cost of £4,000.

Sheffield Health Committee have given an order to the Edison Accumulators, Limited, for an additional electric vehicle for the collection of house refuse.

Perth Tramways Committee have agreed to purchase a motor omnibus on the hire-purchase system from the Scottish Motor Traction Company, Limited.

Liverpool Council have thrown out a recommendation by the Watch Committee for purchasing a petrol motor fire engine from Messrs. Morris, of Salford, at £1,025.

Bacup Council have been informed by the Local Government Board that they cannot sanction a loan of £1,100 for the purchase of a motor fire engine and appliances.

Hackney Council have directed the Highways Committee to consider the advisability of purchasing a motor lorry, owing to the price for horses having gone up to £110 each.

Deptford Council have decided to continue the hire of a motor car for the use of the surveyor. A proposal had been made to discontinue the arrangements, as a measure of war economy.

Aberdeen Cleansing Committee have advised the Corporation to purchase a motor sweeper at an estimated cost of £650, after a deputation has inspected the machines in use at Glasgow and reported upon the most suitable description for use at Aberdeen.

Hull Corporation have made application to the Local Government Board for sanction to borrow £2,665 for the purchase of two motor fire engines. It is felt that motor fire engines are essential if the fire brigade are to be placed in the position to cope with emergencies.

London County Council, on October 19, approved of the action of the Fire Brigade Committee in accepting the offer of Dennis Brothers to supply ten motor fire engines at £975 each, and seventeen motor escape vans at £770 each, and the offer of Tilling-Stevens, Limited, for a motor lorry at £825.

Exmouth Council's new motor fire engine recently underwent a public test and 30-mile run. It is of "Hatfield" design, by Merryweather's, similar to others at Exeter and Devonport. It has a pumping capacity of 350 to 400 gallons a minute, and a speed on the level of between 30 and 40 miles an hour.

Sheffield Electricity Committee, in the third week in October, authorised their chairman and Mr. S. E. Fedden, the general manager, to purchase one or more motor lorries, if available, in order to expedite the delivery of coal to power stations. The result was that they secured a 32 H.P. three-ton Commer tipping wagon.

Sheffield Tramways Committee have empowered the general manager to take what steps he deems necessary in order to comply with the request for motor omnibus facilities between Eckington and Masborough, and to defray from the reserve fund of the omnibus undertaking the cost of purchasing the vehicles that may be required.

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MOTOR TRAFFIC.

STEEL RESEARCH.

ENTERPRISE SUPPORTED BY THE GOVERNMENT.

The Technical Committee of the Society of Motor Manufacturers and Traders, in connection with the Institution of Automobile Engineers, having proposed research upon a matter of such immediate interest that the Admiralty and War Office have appointed representatives on the joint committee, the society guaranteed that £1,000 should be forthcoming, provided the Government would contribute £1,000.

As this research is calculated to benefit more or less directly a number of firms, an invitation was issued to members to guarantee a portion at least of the £1,000 in question. The response has been as follows :—

£100 each.—Daimler Company, Limited; Sunbeam Motor Car Company, Limited; Wolseley Motors, Limited.
£50.—John I. Thornycroft and Company, Limited.
£25 each.—Albion Motor Car Company, Limited; British and Colonial Aeroplane Company, Limited; J. and E. Hall, Limited; Humber, Limited; John Marston, Limited; D. Napier and Son, Limited: J. Samuel White and Company, Limited.
£20.—Handley Page, Limited.
£10 10s. each.—Rudge Whitworth, Limited; Standard Motor Company, Limited.
£10 each.—W. L. Stewart and Company, Limited; Bristol Tramways and Carriage Company, Limited; Halley's Industrial Motors, Limited; White and Thompson, Limited.
£5 5s.—Bowden Wire, Limited.
£5.—Dover, Limited.
£2.—Hoyt Metal Company of Great Britain, Limited.

The secretary of the society informs us that the list is still open.

DAIMLER EMPLOYEES' WAR FUNDS.

Praise must be accorded to the Daimler Motor Works, Coventry, for publishing an eight-page booklet giving a record of the various patriotic works undertaken by those of the employees who are not serving with the forces. The directors subscribed £2,500 to the Prince of Wales' Fund, and undertook to make provision for wives, families, and dependents. At the end of the first year of war these allowances totalled over £8,000, and it only needs a brief perusal of the letters of thanks to see that this generosity is exceedingly welcome, and that it is also a great comfort to the minds of the men at the front. At the beginning of the conflict 221 of the employees were called up to the Regular and Territorial Forces, and 530 have since enlisted. The officers and employees remaining at work have subscribed regularly to a fund established for the purpose of providing assistance to the wives, families and dependents, and in a year the contributions amounted to £4,163, all of which had been distributed, with the exception of £1,600. This sum has been placed on deposit as a contingency fund. All families are assisted regularly, with the result that on many occasions a loan or grant supplementary to the weekly allowance has been opportunely made. As the war proceeds the need also arises for giving extra help to wives whose husbands have given their lives for the country, and to men who have been disabled.

ASSOCIATED BRITISH MOTOR MANUFACTURERS.

The following is the list of the officials of this Association, and of the Committee of Management, so far as it is at present constituted :—Officers—President, Mr. E. Manville; Vice-president, Mr. S. F. Edge; Hon. Treasurer, Mr. G. Holt Thomas; Secretary, Mr. Horace Wyatt. Committee of Management—Messrs. B. Caillard (Wolseley Motors), R. Dennis (Dennis Brothers (1913)), W. M. Iliff (Sunbeam Motor Car), E. M. C. Instone (Daimler), Charles Marston (John Marston), J. Maughfling (J. I. Thornycroft and Company), F. R. Simms (Simms Motor Units), Arthur Spurrier (Leyland Motors), H. T. Vane (D. Napier and Son), and L. Walton (Vauxhall Motors, 1914). The Association are not antagonistic to the Society of Motor Manufacturers and Traders. The relations between the two bodies are entirely friendly and their objects do not overlap. The immediate objects of the Association are to safeguard the future of the British motor and allied industries, and to bring the influence of these industries to bear, with a view to securing that the goodwill of British firms shall not pass into the hands of foreign competitors under the exceptional circumstances created by the war.

OMNIBUS LICENSING AT BRIGHTON.

The town clerk of Brighton has been served with a summons for a writ of mandamus against the Corporation, to hear and determine the application of Thomas Tilling, Limited, for omnibus and chars-a-bancs licenses. The Watch Committee have directed the town clerk to instruct counsel and take all necessary steps to support the action of the town clerk.

MOTOR TRAFFIC NOTES.

OMNIBUSES WITHOUT DRIVERS.—It is stated in the Newcastle Tramways annual report that the motor omnibuses of the department cannot be put in service as the drivers have enlisted.

ENCOURAGING PRIVATELY-OWNED VEHICLES.—Owners of motor vehicles plying for hire in Barnsley have been invited by the Corporation to submit offers for running a daily service to one or more of the outlying districts.

PETROL LORRIES FOR TRACK REPAIRING.—In his report for 1914–15, the general manager of Bradford Corporation Tramways mentions that a petrol motor-tipping lorry of 40 H.P. has been purchased for the permanent way department from the Daimler Company, Limited, Coventry. It has a carrying capacity of three tons, and has proved of great service to the department.

OXFORD OMNIBUS SERVICES.—In pursuance of their policy of linking up the surrounding districts with the city, the Oxford Tramways Company have started a service of motor omnibuses to Wantage. The Highways Committee have reported to the City Council that the horse tramways have been removed and most of the thoroughfares in which they were laid repaired with asphalt macadam.

"COMMER" CAR RECORD.—The two-cylinder "Commer" car, which can be dimly discerned in the accompanying illustration, has

been in constant service for over seven years. It was originally delivered in 1908 to Mr. E. Chesworth, Whitchurch, Salop, and the car is now regularly engaged in carrying 40 soldiers in one load.

MOTOR WAGONS FOR A GAS COMPANY.—Sir W. G. Armstrong, Whitworth and Company have delivered during the past twelve months a dozen one-ton motor wagons to Newcastle and Gateshead Gas Company. The vehicles are used for the delivery of coke, and they are shod with 820 mm. by 135 mm. pneumatic oversize tires. Special tipping gear attached to the bodies enables the load to be easily discharged.

SYDNEY COUNCIL AND ELECTRIC VEHICLES.—In order that the electric lighting department may receive the publications of the Electric Vehicle Association of America, the Sydney Corporation have become annual subscribers to the Association. The Council hope in a short period to do a considerable business in charging the batteries of electric vehicles. Tenders were recently invited for three electric wagons in accordance with the specifications of the electrical engineer.

ELECTRIC OMNIBUS SUGGESTED FOR KEIGHLEY.—Mr. H. Webber, general manager and electrical engineer, Keighley Corporation Tramways, has suggested that a battery-driven omnibus should be obtained for service between Bingley tramway terminus at Crossflats and Stockbridge terminus of Keighley tramways. The route proved unprofitable when worked by a petrol omnibus, but since that time the Bingley tramways have been opened, thus giving a connection with Bradford.

SINGLE-DECK OMNIBUSES ON HILLY ROUTES.—We have frequently advocated the use of the single-deck motor omnibus for several reasons, including general utility, cost of working, and greater safety on gradients. Until a short time ago double-deck omnibuses were used exclusively in Brighton, with the result that the service on hilly routes is said to have been both unsatisfactory and unremunerative. Recently some single-deck vehicles were introduced by the company, with the result that the measure of success attained has been sufficient to lead to a decision to increase the number of this type of omnibus.

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THE Tramway & Railway World
WITH MOTOR TRAFFIC SECTION

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TROLLEY OMNIBUSES versus MOTOR OMNIBUSES.

BY HARRY WEBBER, A.M.I.E.E.

(Borough Electrical Engineer and General Manager, Keighley Corporation Tramways).

Most tramway undertakings at the present time are economising by holding up various schemes which, no doubt, would have been proceeded with in the ordinary course of events. I consider, therefore, that this is an excellent opportunity for any articles which will be of practical use in connection with new schemes to be developed after the present war is over. A time like the present may be termed a "breathing space," when various advantages and disadvantages as shown by practical operation can be thoroughly thrashed out.

The following article is intended to compare the results obtained by the Keighley Corporation with electrically-driven trolley and petrol-driven motor omnibuses. All the data, figures, etc., have been obtained in connection with both undertakings on exactly the same routes, and deal with the same population and class of traffic, so that the comparison could not be more equitable.

There is no doubt that after the war has terminated most tramway managers will hesitate before embarking on any of the expensive systems of tramway track construction, such as the conduit system, and only the cheaper forms of overhead construction will be taken into consideration. Where double track construction had been decided upon for extensions promising only a nominal traffic, a single track will probably be adopted, and for services of from 15 minutes to one hour, in sparsely populated districts, the relative merits of the petrol-driven motor omnibus and the electrically-driven trolley omnibus system will have to be most carefully considered. There is no doubt that they both have their field. The question to be considered

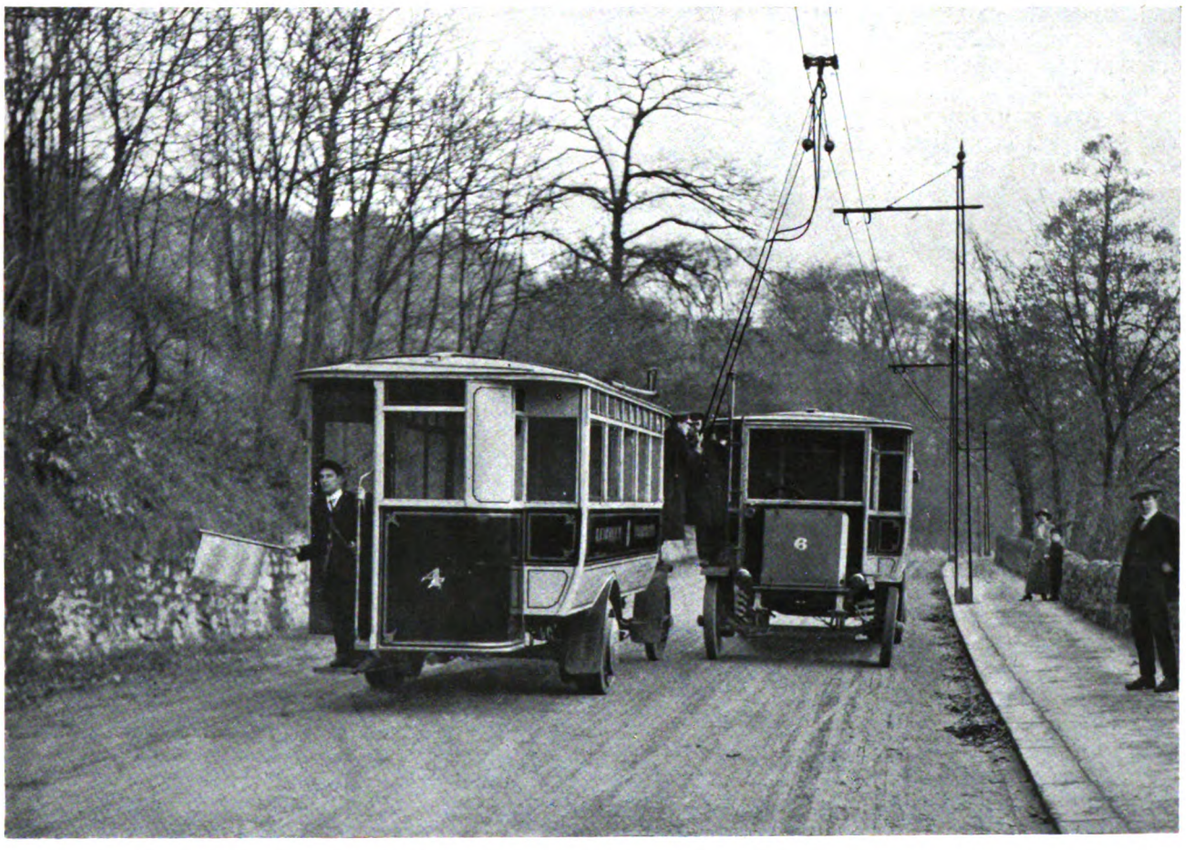

Fig. 1.—Trolley Omnibuses Exchanging Over-running Trolleys in Hawkcliffe Road, Keighley.

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is, when does it pay to erect a simple form of overhead construction, such, for example, as that which has been erected in Keighley for the trackless trolley system, costing less than £950 per route mile; and at what point would such an expenditure be prohibitive? This, of course, depends largely upon local conditions, and the traffic to be catered for.

To anybody casually considering the question, it may not appear to be economical to erect overhead construction for a railless trolley system, when such an outlay can be avoided by using a motor omnibus. I think this question has been demonstrated in a very practical manner by Keighley Corporation Tramways Department, who ran petrol motor omnibuses for five years,and then gave them up in favour of trolley vehicles with the necessary overhead equipment.

It was found impossible to make the expenses meet the receipts with the motor omnibuses, and one factor in the case, which largely decided the question, was that it was costing 2d. per mile in petrol to operate the petrol-driven conveyance. The trolley omnibuses operate over the same routes where the motor omnibus service was in operation, consisting of about nine miles partly undulating and partly very hilly country, at a cost in electricity of under one penny per omnibus-mile. On a mileage of 100,000 per annum, it was found that the difference in power costs alone would cover the interest and depreciation on the overhead equipment, and that left a simple comparison to be made as to what the operation costs, other than power costs, would be.

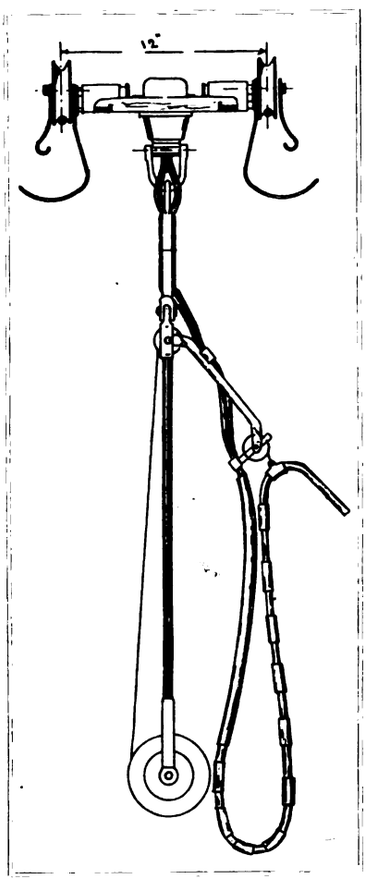

Fig. 2.—Trackless Trolley Current Collector.

Owing to the much heavier weight of the petrol omnibus, and the uneven torque, or turning moment, the relative cost in tires is as 4 to 1 for the same roads in favour of the trolley omnibuses, that is to say, the cheapest mileage contract that could be obtained for the motor omnibuses, for operating over our macadamised road surfaces, was 2d. per omnibus-mile, whereas a contract for three years has been obtained for the trolley vehicles at ½d. per omnibus-mile. I am not attempting to maintain that when a system is large enough to employ a big fleet of motor omnibuses, and has good roads to run on, the figures obtained in Keighley could not be easily beaten; but there are so many places in the United Kingdom where conditions exactly similar to our own do exist, that this comparison should be of the utmost value in such cases. The cost of general repairs in connection with the petrol-driven conveyances is much heavier than in the case of trolley omnibuses.

Another interesting comparison that has been practically demonstrated in Keighley, is the revenue earned per mile from the two types. The motor omnibuses were double deck, and would carry 38 to 40 passengers, but the maximum revenue obtained during the five years they were in operation never exceeded 1s. per omnibus-mile. At the present time, although the trolley omnibuses are only of single deck construction, with a maximum carrying capacity of 28, the revenue is equal to nearly 1s. 2d. per mile. On the face of it, this seems astonishing, but the difference is quite easy to account for when the class of demand is looked into; also from the passengers' point of view the electrically-operated vehicle is infinitely superior. The running is smoother; the operation is odourless; the vehicles can be more attractively lighted; and owing to the absence of a lot of oily material, the trolley omnibuses generally are cleaner throughout.

Where a service is being maintained for a sparsely populated district it is exceptional to get an average of more than six passengers for every mile the vehicle runs, consequently it seems almost absurd to run a vehicle capable of carrying 38 people when the average only requires a vehicle to carry six. We have certain "rush" periods, such as when factory employees are turning out, on market days, holidays, etc., and also generally at week-ends, but these rushes can be easily catered for by an increased number of the smaller vehicles running a quicker service, whilst for the greater part of the time the smaller type will deal with the whole of the traffic.

Another consideration that all Corporations and companies running their own electricity generating stations must bear in mind, is that the amount paid for petrol, apart from taxation, goes into some shareholder's pocket, perhaps in other parts of the world, whereas all profit made on the supply of electricity really comes back into the Corporation's or company's common purse.

It is often questioned whether catering for outlying districts actually improves the net returns on the central tramway services, but this has been clearly proved to be so at Keighley in the transfer from motor omnibuses to trolley omnibuses. During this transfer period, the revenue obtained dropped gradually down from about £6,000 per annum to under £2,000 per annum, which at once resulted in a corresponding decrease in the returns on the central tramway system. We have now been experiencing a steady increase in the returns with the trolley omnibuses, and find that the tramway revenue is showing a similar increase also, there being no other factor to account for this increase. As a logical conclusion from these observations, providing you only just made ends meet by running a service to outlying districts, you will still gain considerably by doing this in improved results on the central tramway installation.

Turning again to the question of petrol as against electricity for motive power, the control of the price of petrol is largely in the hands of powerful syndicates. I believe the retail price of petrol in America at the present time is only about 5½d. per gallon, whereas in this country it is 2s.—that is to say, more than four times the American price. This goes to prove that by adopting petrol as the motive power, you are never quite certain from one month to another what this power cost is going to be, as the price in this country is largely artificial and cannot be said to be under your own control.

In the case of an electricity supply, the matter is entirely different. With Corporations who own electricity undertakings the price is entirely under their own

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control, and even if the energy is bought from a company, fluctuations in price are not likely to occur very often, and are usually in a downward direction. The natural sequence seems to be that motor omnibuses for sparsely populated districts can be used with advantage for running at the extreme end of a railless trolley route about every hour. This would help to feed the railless service, and the trolley omnibuses would again help as feeders to the central tramway in the heart of the town.

I now propose to give a few details of the trolley system just completed in the Keighley district. An article appeared in THE TRAMWAY AND RAILWAY WORLD of October 16, 1913, dealing largely with the experimental length installed as a commencement. This was opened to the public during the spring of 1913, so that in Keighley we have had nearly three years' experience, under very trying conditions, of what the trackless trolley car is capable.

The installation at the present time consists of 8¾ miles of overhead equipment and nine trolley vehicles. The latter were supplied by the Cedes Electric Traction, Limited, of 112, Great Portland Street, London, W., and are of the hub motor type. The overhead equipment was carried out by Messrs. Clough, Smith and Company, Limited, Regent House, Kingsway, London, W.C., and as I consider the proper erection of the overhead wires to be of the utmost importance if the flexible collection system is to be worked smoothly and satisfactorily, I propose to give a brief description, with a number of details, of this part of the equipment.

The type of construction is that known as the over-running, constructed under the patents of the Cedes Electric Traction Limited, and designed for operation with the "Cedes" current collector (Figs. 1 and 2). The poles are of lattice steel design, made in three sizes, each size to withstand the test of the British Engineering Standards Committee's specification for light, medium, and heavy poles.

The three illustrations (Figs. 3 to 5), give a clear idea of what the line looks like on the site. It will be noticed that in one illustration (Fig. 5) is shown the lightest type of pole, which consists of two channel irons with cross bracing. Another illustration (Fig. 3) depicts the heavy type, which is square, made up of four angle irons with lattice bracing. The view in the centre (Fig. 4) gives a fair idea of the surface of the road.

The heavy type of pole simply varies from that shown in the illustration by the thickness of the metal. The bracket arms are of such a length as to enable the trolley wires to be erected a distance of about 4 to 5 ft. from the centre of the roadway. These bracket arms carry two trolley wires of 2/0 S.W.G. gauge, grooved section.

The illustration in Fig. 7 shows a typical shed, as constructed on the longest route, and it has been made lofty enough, so that should a portion of this line be eventually converted into a tramway it will accommodate four or five tramcars. It is of fireproof construction, and was erected at a cost of about £500, complete with concrete floor. It would easily accommodate eight trackless trolley vehicles if necessary.

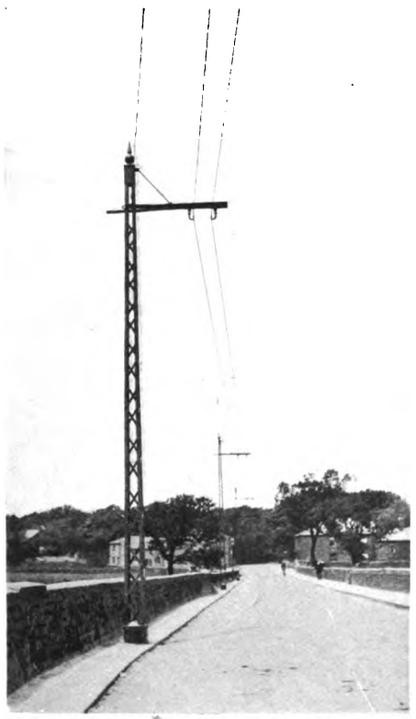

Fig. 3.—Heavy Type of Pole.

Fig. 4.—Hawkcliffe Road, showing Character of Road Surface.

Fig. 5.—Lightest Type of Pole.

As the Cedes system was entirely new in this country, one could not expect to find out exactly what it was capable of doing under English conditions immediately. The first two routes put into operation were both entirely situated on the sides of hills running out of the Worth Valley, and the fact soon became apparent that the standard size of motor for Continental work would not be suitable for the continual strain of uphill journeys under all sorts of weather conditions. As the precaution had been adopted not to order too many vehicles at once, we arranged to have larger motors on the last three or four vehicles, and to exchange those already running on the hilly routes for vehicles with more powerful motors, transferring the original ones to the route more recently equipped, which is practically flat.

The results of the past twelve months' working show a very considerable increase in the popularity of the trolley omnibus as compared with the motor omnibus.

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The vehicle adopted in Keighley is of the single deck type, seating 28 persons. Owing to the very bad weather in winter, and the dust in summer, it was found necessary to close in both the back and front of the vehicle, which added somewhat to its cost, but the effect is well worth the extra expense. The cost of the Cedes gearless vehicle, with a 25 H.P. motor in each of the back wheels, was £720. With front and back closed in, it amounted to £746—that is to say, the first cost compares favourably with a petrol-driven motor conveyance. The capital cost per mile of overhead equipment, with one pair of wires, amounted to £923. With the Cedes system it is only necessary to have two wires, as the exchange of sockets is so simple and easy to carry out that the provision of more than two wires is superfluous, unless a large number of vehicles run consecutively on the same route. In Keighley, three vehicles are operated together on a length of 4¼ miles with no trouble whatever.

As there are various extra expenses over and above the actual cost of overhead equipment and vehicles, I think it will be worth mentioning here the exact total cost for 8¾ miles of route. The cost of 8¾ miles of overhead equipment, together with extras for digging in rock and expenses of alterations to post office telegraphs, etc., has amounted to about £9,000.

The three garages, one for each route, have cost roughly £1,000 in all, the nine trolley omnibuses complete cost about £7,000, making a grand total of about £17,000, or £1,943 per mile of route for the complete installation.

The following tables give actual results obtained with petrol-driven motor omnibuses for the year ended March 31, 1912 (which is a fair average year), compared with results obtained with trackless trolley vehicles for the quarter ended June 30, 1915 :—

	Motor Omnibuses	Trolley Vehicles.
	Per Car-mile.	Per Car-mile.
Income.	Pence.	Pence.
Traffic revenue	11·062	13·43
Advertising	·075	·202
Sundry revenue	—	·08
	11·137	13·712
Expenditure.		
Superintendence	·137	·202
Wages of chauffeurs and conductors	2·606	2·469
Cleaning and oiling	·530	·346
Fuel, light, and water	·198	·060
Ticket check (including wages of clerks and inspectors)	·353	·359
Uniforms and badges	·208	·104
Licenses for vehicles, etc.	·070	·020
Proportion of salaries (borough treasurer and staff)	·063	·025
Borough fund charges	·031	·037
Printing and stationery	·102	·027
Rates and taxes	·030	·157
Third party insurance	·489	·207
Workshop tools and sundry plant	·015	·021
Chassis	3·556	1·521
Tires	2·255	*·404
Bodies and fittings	·185	·252
Fire insurance	·043	·020
Power	†1·992	·891
	12·863	7·122
Interest and repayment of capital	2·972	2·834
	15·835	9·956
Balance per car-mile	Loss 4·698	Profit 3·756

* The actual figure given for tire cost is for the three months, and is only ·404d. owing to the fact that one or two of the vehicles had not quite run out their 10,000 mile guarantee. The cost in any case will not exceed ·5d. per car mile.

† This average is based upon the cost of petrol on March 31, 1912, and at the present price of petrol, inclusive of extra taxation, a proportionate increase must be made in considering new undertakings.

During the five years that the petrol-driven machines were in operation, the total loss on this undertaking was £5,652.

Up to the present date the trackless trolley working over the same routes has paid for itself, and with a good margin of profit left over. The installation has only been in complete service since March of this year, and the figures to date give a proof that instead of making a loss of approximately £1,000 a year, as was the case with

Fig. 6.—Trolley Omnibus Waiting at a Terminus.

motor omnibuses, the profit will amount to somewhere approaching £1,000.

Independent of other considerations, there is no doubt from a highways point of view that the trolley omnibus is preferable, as it has a very small detrimental effect on the road surface as compared with a petrol machine.

A few years ago popular opinion was distinctly in favour of railless traction as the next best thing to a tramway on rails. Because of some few troubles having

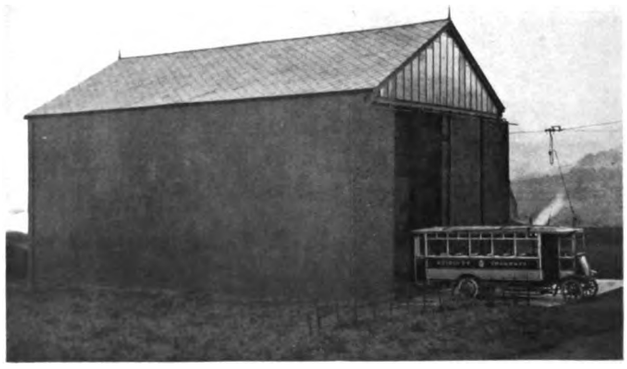

Fig. 7.—Trolley Omnibus Shed at Utley, Capable of Housing Tramway Cars.

been experienced on some of the pioneer lines put down for railless traction in this country, a number of managers, who were then interested in the subject, have been inclined to turn their attention to the motor omnibus, and have lost sight of the gradual perfection of the railless trolley omnibus. I think the increased takings at Keighley on the trackless trolley undertaking, as compared with the motor omnibuses, shows clearly which of the two the general public prefer, whilst from a financial and general management point of view,

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there is no doubt that the former are more suitable, at least for districts similar to Keighley.

In England there is a tendency to start off with a very lavish expenditure, more particularly on the buildings concerned with a tramway undertaking. An additional sum of £6,000 to £8,000 can easily be expended in this way upon a small undertaking, without any increased earning power for that extra capital expenditure.

In dealing with the trackless extensions at Keighley, a policy has been adopted of refraining from lavish expenditure in all directions, so as to give the enterprise a chance to pay its way from the beginning. When it has developed, and is showing a steady profit on the capital expenditure, then money can be expended on what may be considered desirable, although not absolutely essential, acquisitions.

on hills and routes similar to those round about Keighley, there are not many places where it would not do even better. At the present time in Keighley, wages and the cost of materials are considerably in advance of what they would be under normal conditions, whilst the fares have been left the same, no increase being made on account of the war. Consequently, any results obtained now should be improved upon when the country is in a settled state.

The figures, and in fact the whole of the foregoing article, are based on experience obtained in the Keighley district, but seeing that the comparisons have been made between two classes of vehicles on exactly the same routes and under exactly the same conditions, the conclusions should be applicable to any other part of the country.

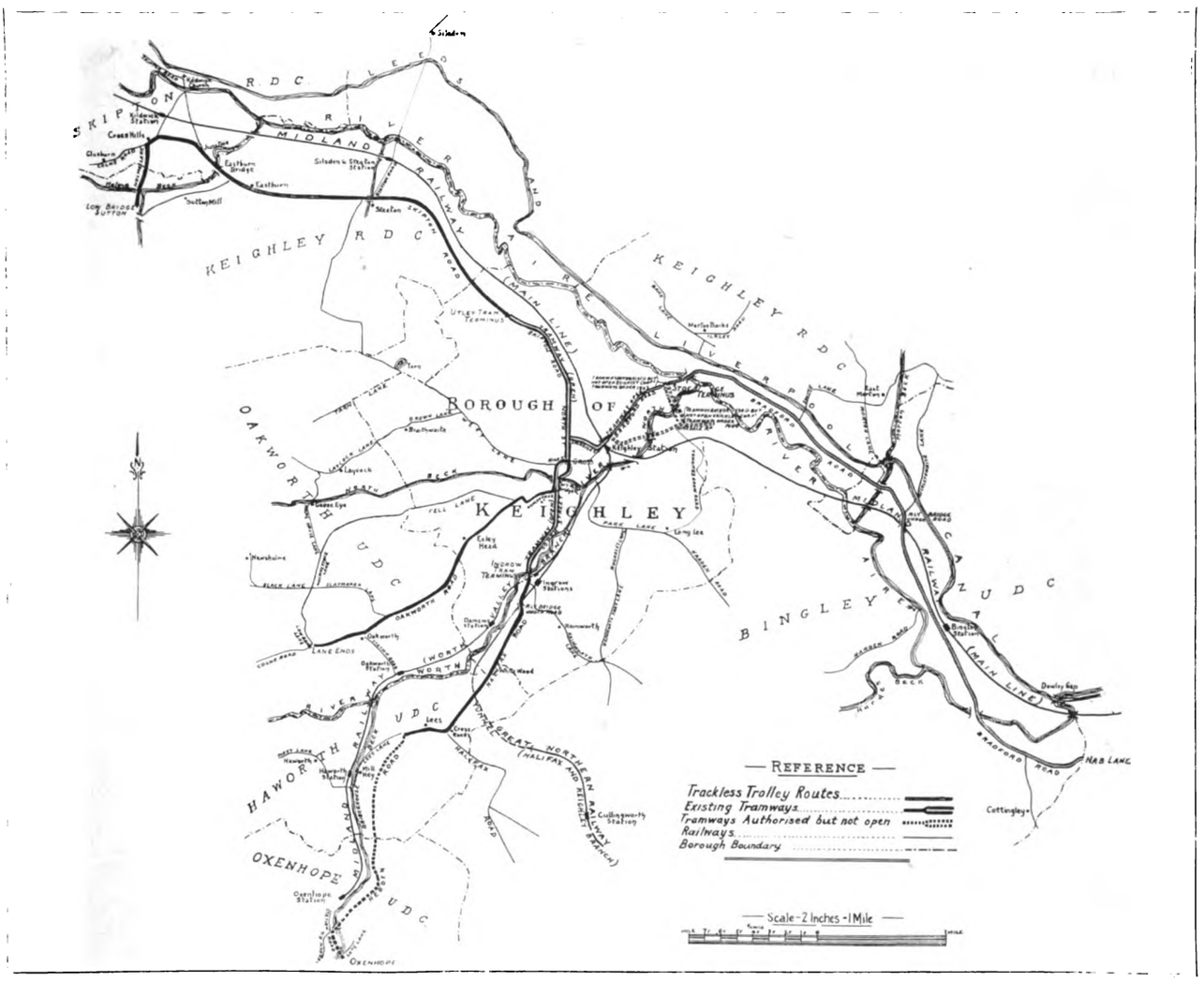

Fig. 8.—Map of Keighley Tramways and Trolley Omnibus Routes.

The tendency now apparent all over the country for better road surfaces to be maintained, is all in favour of trackless as against tramway systems. Although cars on rails only actually wear the rail that they run on, there is no doubt that the presence of rails in the surface of a roadway makes the maintenance of that particular road more expensive, and a road surface without rails is more desirable for the general public than one with rails.

Moreover, nearly every town of importance now has its own electricity generating station, and in such cases I have no hesitation in emphatically stating that electrically-driven vehicles should be adopted in preference to petrol-driven ones. Finally, there is not much doubt that if a trolley vehicle will give satisfaction

TRAMWAY TRAFFIC RECEIPTS INCREASE.

The official traffic returns of 50 of the principal tramway undertakings in the United Kingdom, other than those in the Metropolitan area, for the last week in November, gave total receipts of £163,590, or £10,353 more than in the corresponding week of last year. The total length of track was 2,292 miles, or 25 more than for the corresponding week. The receipts this year were at the rate of £71 7s. 5d. per mile of single track, and last year at the rate of £67 12s. 6d., thus showing an increase for the correspon ling week of £3 14s. 11d. per mile open. The principal London tramways have temporarily suspended the publication of traffic returns.

The Footscray (Victoria) Council is considering the construction of an electric tramway covering a distance of about six miles. The name of the consulting engineer may be obtained by United Kingdom manufacturers and contractors interested on application to the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

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THE THOMAS TRANSMISSION LOCO-COACH.

The 200-H.P. loco-coach which the Thomas Transmission Company recently built to the order of the New Zealand Government Railway Department has, in spite of the war, attracted so much attention from railway engineers that we believe a detailed description of it will be welcomed by our readers. As was pointed out in our issue of July 8, the conditions of service specified by the New Zealand railway officials were by Mr. Thomas during two prolonged visits to South Africa in connection with the Leyland-Thomas 160-H.P. railcar supplied to the South African Railways some three years ago. It is the latest example of the application of the Thomas system to rail traction.

The engine, specially designed and built for the purpose by Messrs. J. Tylor and Sons, Limited, embodies several features which are new both in road and rail traction. Owing to the importance of keeping down the length of the engine compartment, the "V"

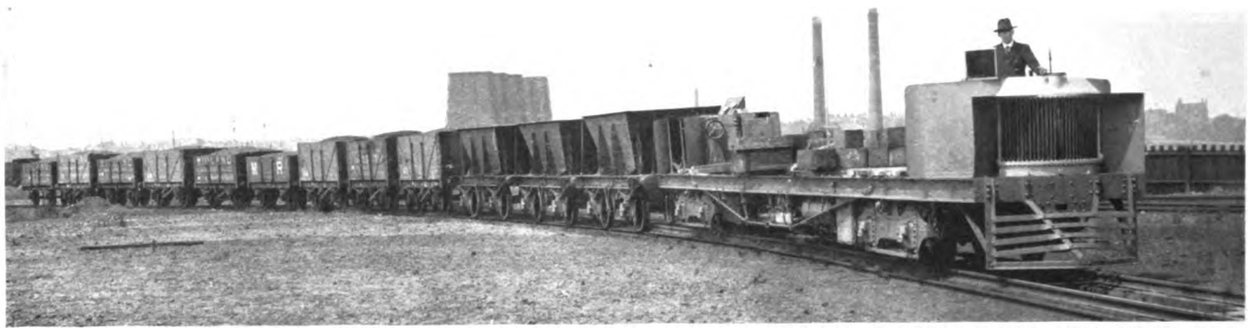

Fig. 1.—Coach Drawing 200-Ton Load Round a Sharp Curve.

exceptionally severe, varying from a speed of 40 miles per hour on the level with a gross load of 85 tons, to a speed of 10 miles per hour up a grade of 1 in 40 with the same load, the coach alone to be capable of taking the specified grade at a speed of 28 miles per hour.

Unfortunately only a very short 3 ft. 6 in. track was available in this country on which to test the coach before shipment. In Fig. 1 the coach is shown on this short track drawing 200 tons load round a sharp curve, and the manner in which it quickly accelerated this heavy load was excellent evidence of its hauling power. Very soon the results of the coach tests in New Zealand will come to hand, and we hope at a later date to refer to them. In the meantime the description which follows should be of special interest, as very considerable developments in petrol rail traction, especially for military purposes, have been taking place during the current year.

The general design of this coach, which can be clearly understood from Fig. 2 and from drawings reproduced in Fig. 3, was the result of special experience gained construction was adopted, as will be seen in Figs. 4 and 5. There are eight cylinders in two sets of four at 60 deg., each cylinder being separately cast and having 7 in. bore by 8 in. stroke. For the sake of extra strength and rigidity, all the cylinders are recessed into the crankcase. The normal speed of the engine is 900 revolutions per minute, at which speed it will develop slightly over 200 H.P. The maximum speed for short periods is 1,500 revolutions per minute. Opposite cylinders act on the same crank, one of each pair being provided with a forked connecting rod which has bearings on the outside of the main brasses of the single rod.

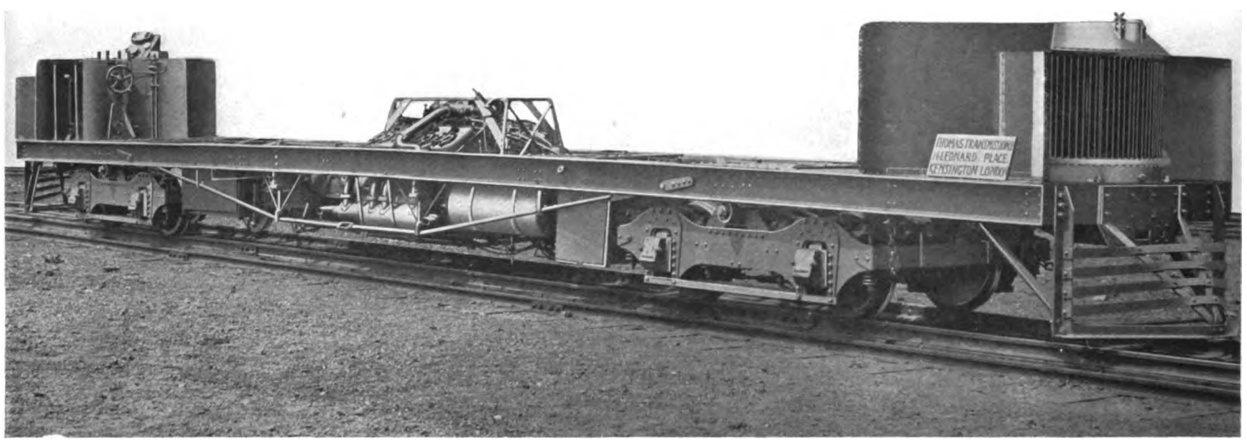

Fig. 2.—General View of 200-H.P. Thomas Transmission Locomotive Coach.

The main induction pipe, from which branch pipes are led to the two rows of cylinders, is located longitudinally inside the "V," and has a Claudel-Hobson carburetter fitted to each end. These carburetters therefore work in parallel, and the whole system is so arranged that there is a steady and continuous suction. Two separate magnetos are provided, one for each set of cylinders. Special care has been taken to

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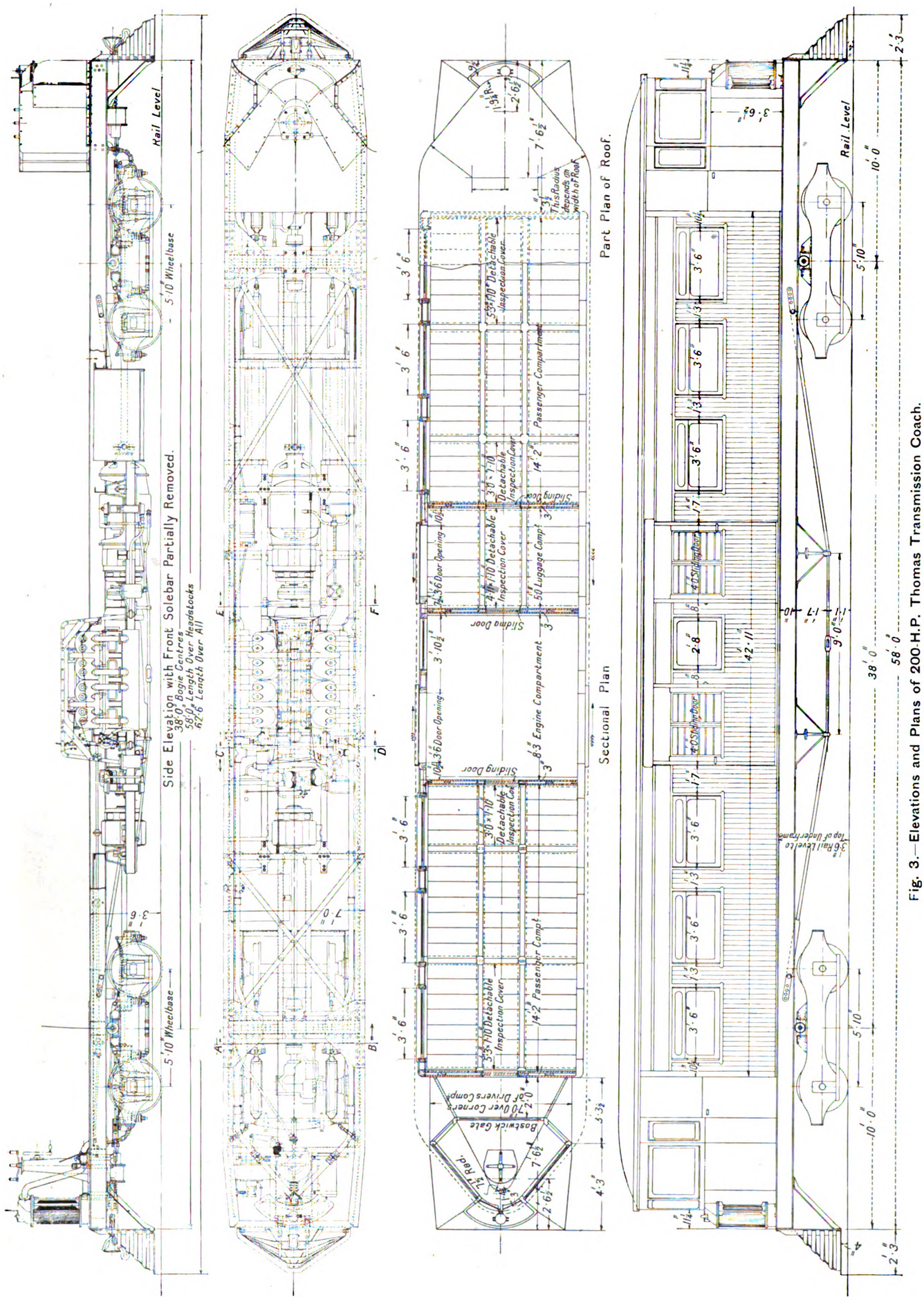

Fig. 3.—Elevations and Plans of 200-H.P. Thomas Transmission Coach.

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provide ample water space round the cylinder heads and valves, and as will be seen these are placed on the outside of the "V" for the sake of accessibility, a feature which is a departure from the usual "V" construction. Two silencers are provided, one for each row of cylinders, and these are located on opposite sides of the engine on a level with the bottom of the crank case between the engine and the coach frame.

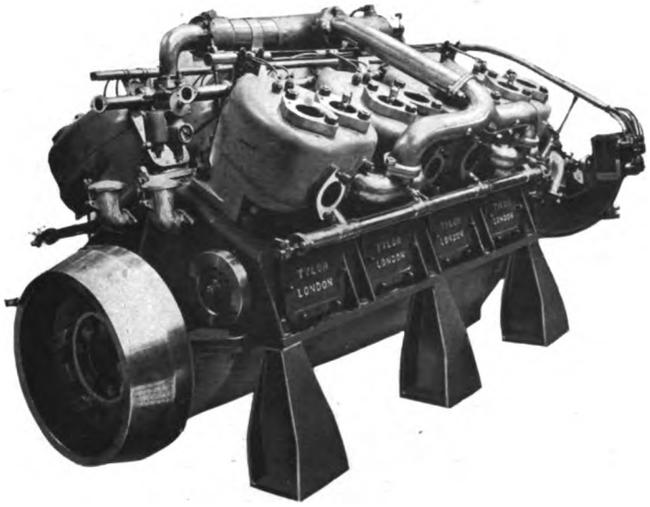

Fig. 4.—Three-quarter View of 200-H.P. Engine.

As the vehicle has to run equally well in either direction, the engine is of the reversible type, the reversing system being that originally due, we believe, to Thornycroft's, the governing feature of this system being that there is a set of reversing bevels in the drive between the cam shafts and the crank shaft, so that the former and also the pumps and magnetos always rotate in the same direction. No hand-starting gear is necessary, because with the assistance of the electrical apparatus which forms part of the transmission system the engine can be started up electrically in either direction in a few seconds.

The small flywheel, which can be seen at the end of the cam shaft in Fig. 4, is mounted on that member to relieve the gearing of sudden shocks when lifting the exhaust valves.

In the case of the South African coach, the radiators were placed upon the roof of the vehicle, but in this latest design they are located at each end, provision being made to allow ample draught of air through both radiators irrespective of the direction of motion of the vehicle. Circulation of the water is effected by means of two centrifugal pumps, and the lubricating oil by means of ordinary gear pumps, all driven from the engine. Owing to the special method of reversing the engine, the only member that reverses its direction of rotation is the crank shaft, thereby allowing the pumps with the magnetos and cam shafts to rotate always in the one direction.

The outstanding feature of the coach is the method of power transmission, and although this follows in the main the earlier practice as applied to the South African coach, a number of important improvements have been made, both in location and in connection with the details of the transmission itself. As at present constructed this apparatus, which in effect is an electro-mechanical variable speed gear, consists of three elements :—(1) A planetary casing, in which are mounted duplex pinions of different diameters, one meshing with a large and the other with a small sun wheel, mounted respectively on the "load" and auxiliary shafts, the casing and the two sun wheels forming three independent members of a differential planetary gear ; (2) two electrical machines, driving or being driven by each of the shafts on which the sun wheels are mounted ; (3) an electrical controller, by which the electrical condition of the two electrical machines can be varied at will. The diagram, Fig. 6, shows the arrangement of the power and transmission units, the method of operation being as follows :—

The engine driving shaft A is permanently connected to the casing B of the planetary gearing. This casing carries a set of planet wheels on two spindles which are supported in roller bearings in the sides of the casing. Each spindle has rigidly fixed to it two planet wheels of different diameters, and these in turn mesh with two sun wheels. The larger sun wheel drives the outside axle of one bogie through the free-wheeling magnetic clutch E and the driving shaft D. The final drive to the axle is by means of a bevel and spur reduction. The smaller sun wheel is connected direct to the armature of the first electrical machine C, and a second magnetic clutch F is provided for locking this machine to the shaft A, or, what amounts to the same thing, of locking the planetary gear so that the case and contents rotate as one piece.

The second electrical machine G is located on the opposite side of the engine, and is connected with the outside axle of the second bogie by means of a cardan shaft and a bevel and spur reduction, as in the case of the first bogie.

In order to start the engine, the clutch E is disengaged and the clutch F engaged. This locks the gearing, and the first electrical machine C is thus locked solid with the engine, so that when the battery provided for the purpose is connected across the series machine C the engine is caused to rotate and starts up.

In order to understand the action of the gearing, let it be assumed that both clutches are disengaged. When the engine drives the casing B a differential action is set up between the large sun wheel and the small sun

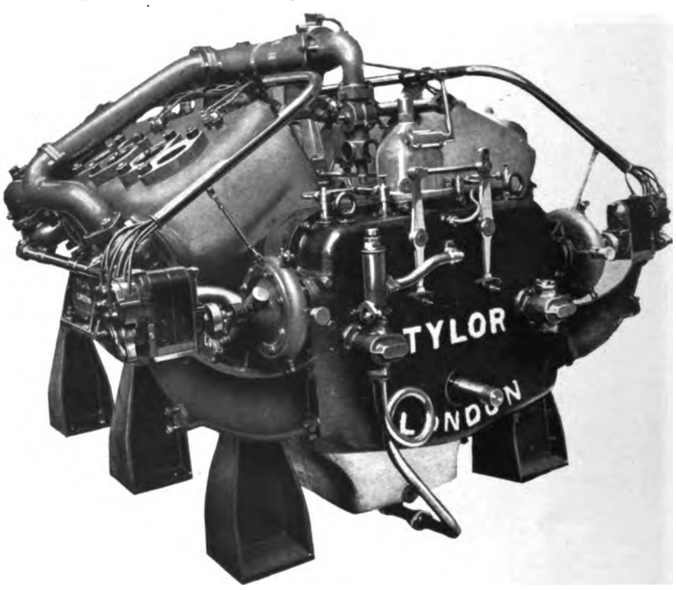

Fig. 5.—End View of 200-H.P. Engine.

wheel. The large sun wheel tends to rotate forwards in the same direction as the engine and the small sun wheel tends to rotate backwards in the opposite direction to the engine. If the clutch E is engaged, then the large sun wheel will be held stationary as it is connected direct to the load, and as the small sun wheel is free, it will rotate backwards at a speed somewhat greater than that of the engine. If current is taken from the machine C the motion of the small sun

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wheel will be retarded, so that the large sun wheel, i.e., the load, must begin to move. By manipulation of the field of the machine C this action can be continued until the small sun wheel is practically brought to rest, and the large sun wheel caused to rotate at about half engine speed.

During this initial period the current from the machine C is transmitted to the second machine G, which, acting as a motor, drives the second bogie electrically. It is clear therefore that there is a mechanical drive to the first bogie and an electrical drive to the second bogie.

The next operation is to increase the speed of the large sun wheel gradually until it reaches the engine speed, so that the gearing can be locked solid by means of the clutch F, and a direct drive obtained for top speed.

This speeding up of the large sun wheel from half speed to top speed is obtained by changing the functions of the two electrical machines, and causing G to act as a generator and supply current to C as a motor, driving the latter in the same direction as the engine. This operation is a gradual one, and is carried out by manipulation of the field of the machine G. When the sun wheels and the casing have reached a common speed, the magnetic clutch F is engaged, so that the electrical transmission is cut out altogether and a direct drive obtained from the engine to the first bogie.

direction. When this emergency reverse is used it is of course not necessary to go through the somewhat more lengthy process of reversing the engine in the manner previously described. Fig. 7 shows the transmission unit, while the arrangement of the power unit and transmission gearing is indicated diagramatically in section in Fig. 6.

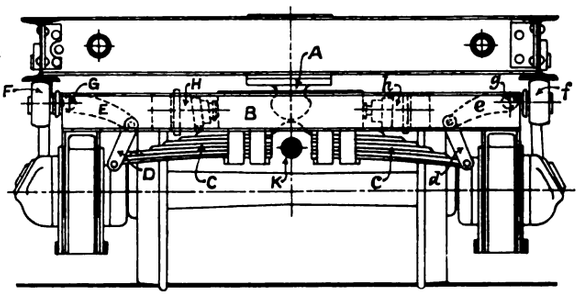

Fig. 8.—End Elevation of Thomas Compensating Bogie.

The control is exceedingly simple and can be effected from either end of the vehicle. The main controller provides for 12 forward speeds, including direct drive on top. The reverse for continuous working is obtained as already stated by reversing the direction of rotation of the engine, and using the twelve controller

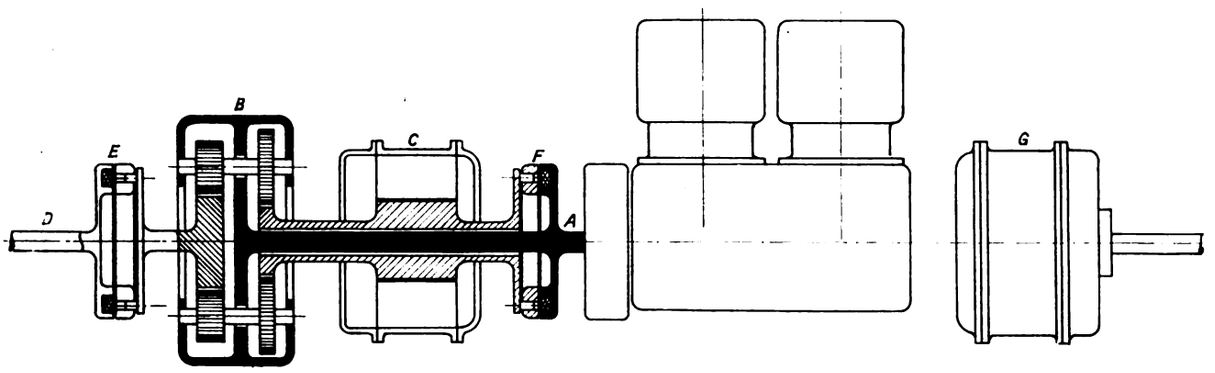

Fig. 6.—Diagram Showing Arrangement of the Power Unit and Transmission Gearing.

When the vehicle is travelling on top speed the two electrical machines C and G, being inoperative so far as propulsion is concerned, can be conveniently utilised for charging a medium size battery which is carried on the vehicle with the object of providing current for starting up the engine, and for lighting or for other services requiring moderate power. It should be

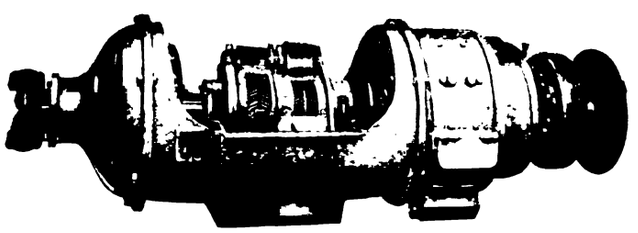

Fig. 7. Transmission Unit with Cover Removed.

specially pointed out that this battery is not an essential of the transmission system, and that it is not at any time used for supplying current for propelling the vehicle.

For shunting and reversing for very short distances an emergency reverse is provided, which works in the following manner :—The clutch E is disengaged and the clutch F engaged, so that the machine C is locked solid with the engine. Current is then taken from this machine as a generator to the second machine G acting as a motor with a reversed field, and the vehicle driven purely electrically from the second bogie in the opposite

speed notches as in the forward direction, while two extra notches are provided for the emergency reverse.

In addition to the main controller an auxiliary switch is provided, which is used to control the car in very much the same way as the clutch pedal on an ordinary touring car. Both of the clutches can be disengaged by putting this auxiliary switch in the " off " position. It will thus be seen that if at any time the driver wishes to bring the vehicle to rest, it is not necessary to move the main controller, the act of freeing the engine being obtained by moving only the auxiliary switch lever.

An important improvement has been made in the design of the latest Thomas locomotive-coach by the introduction of the Thomas patent compensating bogie, the drawings of which are shown in Figs. 8 and 9, and the bogie itself illustrated in Fig. 11. The ordinary king pin is replaced by a spherical headed pin A, which is supported in a bolster box B, provided with a spherical socket to receive the pin A. This bolster box has a cover which fits round the neck of the spherical pin A and prevents any lifting from the spherical socket. The bolster box B is supported on laminated springs C–C, which at their ends are supported on swinging links D–d_1. These links are suspended from the ends of bent levers E–e, which carry at their opposite ends supporting rollers F–f, the latter bearing upon the sole bars of the main frame of the coach. These rollers

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take the place of the friction plates provided in the usual construction of bogie.

The levers E–e_1 are carried on fulcrum pins G–g, which are supported in brackets on the bogie frame. In order to prevent excessive swinging of the body, coned coiled springs H–h bear upon the sides of the bolster box B.

It will be clear from the construction shown that the G–g_1. The distribution of this weight can be varied according to requirements, by adjustment of the relative lengths of the arms of the levers E–e. If considered advisable, half the weight can be carried on the bolster box B and one quarter on each of the rollers F–f.

The object of this construction is to keep the weight distributed between the main spherical pin A and the

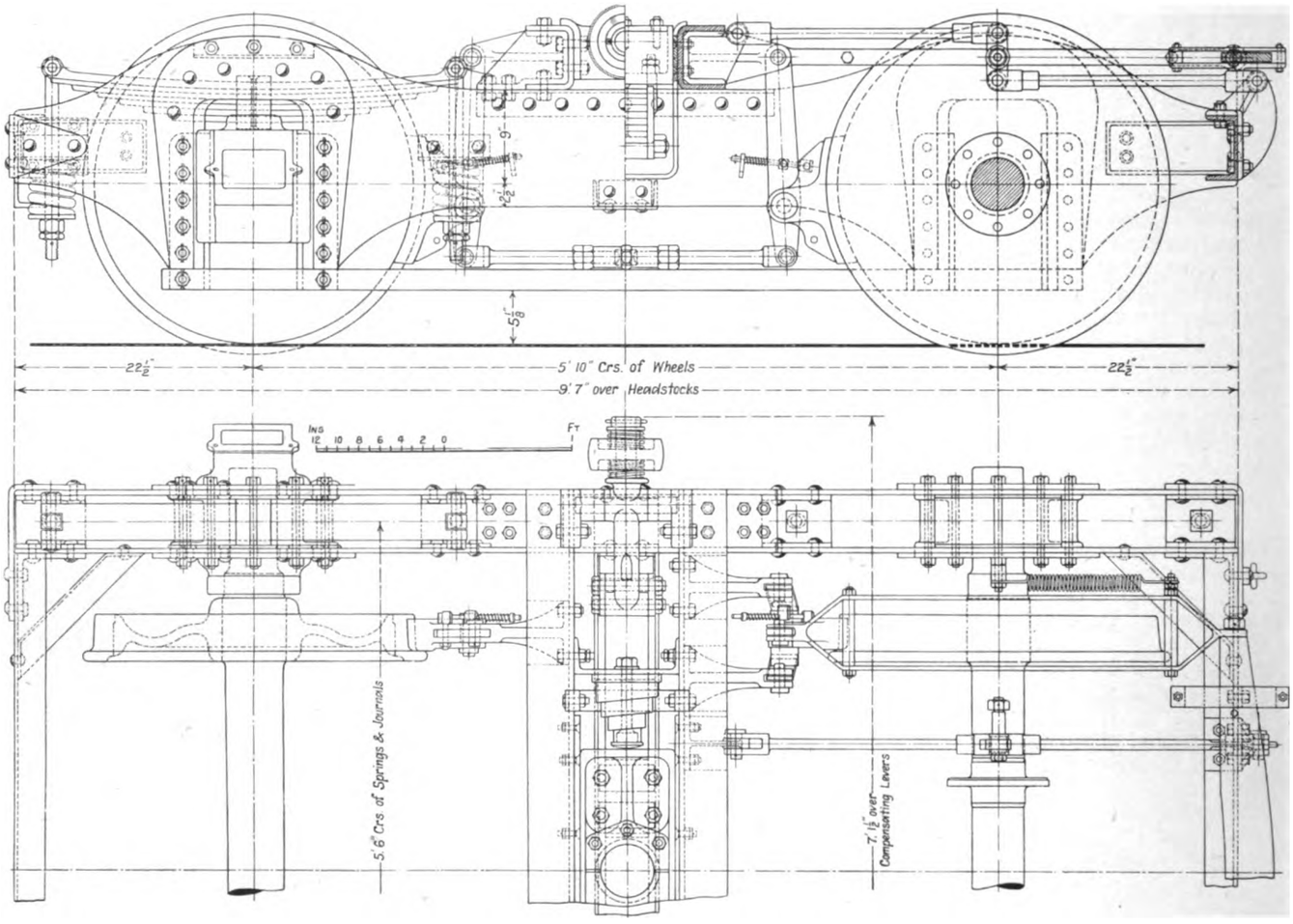

Fig. 9.—Half Plan and Elevation of Thomas Patent Bogie.

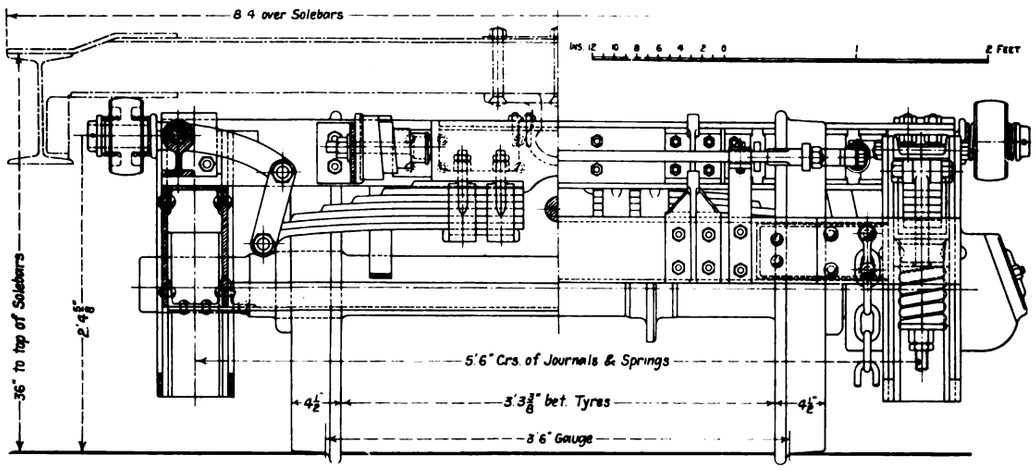

Fig. 10.– Half End Elevation and Half Section of Thomas Patent Bogie.

ordinary bogie bolster is replaced by the bolster box B and the springs C–c. The weight of the main frame with power equipment and body is distributed between the spherical pin A and the two rollers F–f, the whole weight being therefore supported on the fulcrum pins side rollers F–f and also to minimise rolling of the body. It will be clear from the above description that the first object has been achieved, and a consideration of the design will show that oscillation has been reduced to a minimum. When the vehicle is rounding a curve and

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cants towards one side—say, to the left—the movement will cause a depression of the roller F and the end of the lever E which carries the link D will rotate upwards; owing to the bend in the lever, its upward motion will also be slightly inwards towards the centre of the bogie. On the right-hand side the motion will be reversed, the roller f will be raised and the end of the lever e supporting the link d will rotate downwards and outwards.

This motion of the levers supporting the links will move the springs and bolster box, together with the main frame slightly towards the right, and transfer some of the weight from the roller F to the roller f, thus causing a slight depression of f, and tending to restore the body to its horizontal position.

The body is thus always supported at the sides, and, further, when travelling over an uneven track the bogie is free to oscillate, following the inequalities of the track, without transmitting the swinging motion to the body.

In order to allow free movement of the rollers transversely when the main frame moves from side to side, coiled springs are fitted on the ends of the levers on either side of the rollers. These springs tend to keep the rollers in a central position, but if movement takes place the spring on one side becomes compressed. For ordinary bogies the springs C–C could be made in one piece, but in this particular design they had to be divided in order to allow a passage for the propellor shaft K which passes through to the outside axle.

It is claimed that a bogie of this construction is simpler, lighter, and cheaper than any of the usual

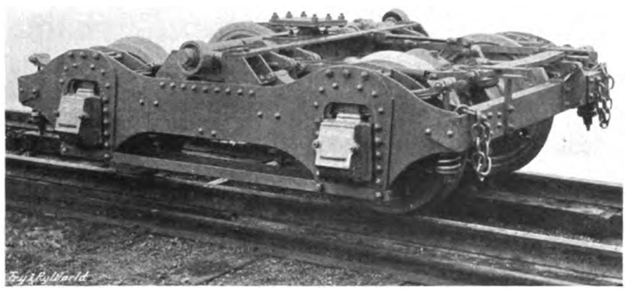

Fig. 11.—Thomas Bogie Truck.

types. If this claim can be substantiated, then this new bogie should find ready acceptance for ordinary rolling stock, on account of the smooth running qualities that it obviously possesses.

The general design of the frame has had very careful consideration, with a view to keeping down the weight of the vehicle without sacrifice of strength. One of the improvements in mechanical details has been the rearrangement of the cardan drive to the back axle. In the early model the universal joint provided to allow for the motion of the bogie about its king pin centre was placed directly below the latter point. The latest arrangement provides two universal joints, one on each side of the king pin centre and equi-distant from it, the object being to insure that for all positions of the bogie, the angular velocity of the final drive on the axle would be perfectly uniform, a refinement perhaps unnecessary when such long cardan shafts are used as those shown in Fig. 3.

Westinghouse brake equipment has been installed, in addition to powerful hand brakes which are provided for emergency use. The compressor for the air brake is coupled direct to the crank shaft of the engine. The weight of the complete vehicle, exclusive of the body, which is being constructed by the New Zealand railway department in their workshops at Wellington, is approximately 24 tons, of which the engine, transmission, and radiators weigh about seven tons.

CHICAGO RAILWAY TERMINI NOT TO BE ELECTRIFIED.

The Chicago Association of Commerce Committee on smoke abatement and electrification of railroad termini find that the complete electrification of Chicago's railway termini is not considered financially feasible at this time. While the electrification plan is technically possible, the cost is placed at $290,000,000.

As regards individual railways the report says: "The financial practicability, under present day conditions of electrification as it might be applied to individual roads, or to single services of individual roads, is a matter which has not been investigated by the committee and concerning which no opinion is expressed."

Air pollution by the railways is classed in the minor list and city cleaning is needed to get rid of polluted air. A pure air commission is recommended for the city. "It is not the opinion of this committee," reads the report, "that the immediate or general electrification of railroads for the purpose of eliminating their part in air pollution is under present conditions either advisable or practicable."

In its final analysis the report sets out the issue as follows:—

"The complete electrification of the railroad terminals of Chicago as a betterment to be brought about by the railroads through the investment of free capital is under present day conditions impracticable."

These three points are emphasised:—

"1. The launching of such an undertaking to be participated in by all the railroads at practically the same time, would involve a large amount of experimentation.

"2. The problem of contact design, when considered in relation to normal railroad operation, presents many difficulties. A limited amount of trackage in the Chicago terminals is so located that it has been found impracticable to equip it with any form of contact system. Operation over such trackage, subsequent to electrification, will need to be conducted by some form of self-propelled unit, or there must be some rearrangement of tracks. The difficulties imposed at numerous points by insufficient clearance of overhead structures will, under the plans of the committee, be met by the installation of warning devices, or the enforcement of regulations governing the presence of trainmen on tops of cars.

"3. The technical difficulties to be met and overcome in bringing about the complete electrification of Chicago's terminals will, through the general development of the art, diminish year by year. Therefore, the longer the undertaking can be delayed, the more certain will become the procedure by which the electrical establishment can be secured."

PUBLIC SERVICES AND RECRUITING.

On November 20 the Local Government Board issued a circular to local authorities giving instructions for the appointment of the local tribunals under the new recruiting scheme, and for their guidance in dealing with the cases that come before them. The principal duty of the tribunals will be to adjudicate on the claims of men of military age and fitness to be excused service on the ground that they are indispensable in a trade, etc. Accompanying the circular was a list of occupations scheduled as "vitally important at the present time for war work or for other essential requirements." List D of this document comprises "reserved occupations of cardinal importance for the maintenance of some other branches of trade and industry." Among the occupations are those connected with electric light and power supply and public utility services, including tramways, waterworks, and canals. "Skilled men in these undertakings," the document adds, "if attested and classified for Section B (Army Reserve) will not be called up for actual service with the colours unless their employer states that their services can be spared."

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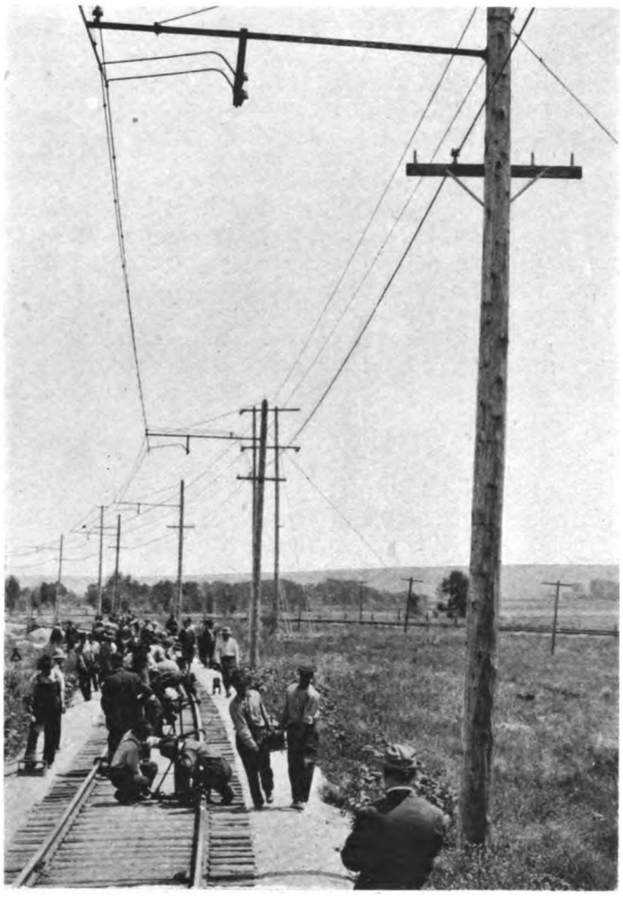
ELECTRIFICATION OF THE CHICAGO, MILWAUKEE, AND ST. PAUL RAILWAY.

NOTABLE PROGRESS OF AN EXTENSIVE SCHEME.

In our issue of February 11 last was published an illustrated description of the proposed electrification of the Chicago, Milwaukee and St. Paul Railway. The work has been actively carried on since the order for equipment was placed with the American General Electric Company in September, 1914, and in view of the magnitude of the scheme the progress made to date has been remarkable. We now publish a further description that has been sent to us through the courtesy of the British Thomson-Houston Company, Limited, of Rugby.



Overhead Line Construction on Curve.

The overhead construction, which will include 650 miles of single track, has been completed for a distance of more than 200 miles. The 100,000-volt transmission line being erected by the railway company to parallel the electrified tracks has been completed for an equal distance, and feeder lines from the 100,000-volt system of the Montana Power Company are ready for service. The track now ready for train operation includes extensive yards and sidings at Three Forks, Deer Lodge, and Piedmont, and passing tracks at other points.

The accompanying illustrations show the general appearance of the new type of trolley construction and transmission lines. Wood pole construction is used throughout, both for cross span and bracket construction. The twin 4/0 trolley wires are suspended individually and separately from the same steel catenary, and the hangers of one trolley wire are placed at points mid-span on the other. In the shunting yards only one trolley wire is used.

Seven sub-stations designed to supply power to the first half of the 440 miles of route have been completed, and the equipment of four sub-stations is practically ready for operation. The erection of the remaining seven sub-stations shown on the profile between Deer Lodge, Montana, and Avery, Idaho, is proceeding. The sub-stations and their equipment are as follow :—

Name.	Miles from Avery.	No. Units.	Size M.G. Sets Kw.	Total Kw.	Size Trans. K.V.A.	Total K.V.A.
Two Dot	425·6	2	2,000	4,000	2,500	5,000
Summit	392	2	2,000	4,000	2,500	5,000
Josephine	361·8	2	2,000	4,000	2,500	5,000
Eustis	331·8	2	2,000	4,000	2,500	5,000
Piedmont	289·1	3	1,500	4,500	1,900	5,700
Janney	261·7	3	1,500	4,500	1,900	5,700
Morel	228·3	2	2,000	4,000	2,500	5,000
Gold Creek	192·7	2	2,000	4,000	2,500	5,000
Ravens	160	2	2,000	4,000	2,500	5,000
Primrose	122·2	2	2,000	4,000	2,500	5,000
Tarkio	85·6	2	2,000	4,000	2,500	5,000
Drexel	47·5	2	2,000	4,000	2,500	5,000
East Portal	23·7	3	2,000	6,000	2,500	7,500
Stetson	3·6	3	1,500	4,500	1,900	5,700
		32		59,500		74,600

Each of the motor-generator sets consists of a 60-cycle, 3-phase, 2,300-volt synchronous motor, direct connected to two 1,500-volt direct current generators. The generators are connected permanently in series to supply 3,000 volts to the trolley. Each set is also provided with an exciter at each end, one providing excitation for the revolving field of the motor and the other supplying the separately-excited fields of the d–c. machines.

These sets are in general similar to the five 1,000-KW. 2,400-volts units in operation on the Butte, Anaconda and Pacific Railway. A new feature, however, consists of a longitudinal ventilation of the core and field coils similar to that employed in the GE ventilated railway motor. The use of this method of cooling has effected a considerable reduction in the floor space required per kilowatt.

The d–c. generators are equipped with commutating poles and compensated pole-face windings to insure sparkless commutation under heavy overloads. This overload capacity is 150 per cent. normal load for two hours and 300 per cent. normal load for periods of five minutes. This will provide ample margin for starting a train of maximum tonnage on the most difficult grades.

It is interesting to note in connection with these sub-stations that the motor-generator sets are designed to operate inverted in case the regenerated power exceeds that required by other trains operating near by. For this reason there is no necessity for water boxes or other energy-consuming devices, since the excess energy is transmitted to the 100,000 volt system.

The main direct-current switchboard in each station represents the latest practice in high voltage direct-current switching apparatus. A panel is provided for each set, and two panels are provided for feeders in each direction. The circuit breakers and switches are mounted on separate panels located above and a short distance back of the main panels, similar in general to those now operating in the Butte, Anaconda and Pacific sub-stations. The control handles for operating the breakers and switches are located on the main panels and are connected to the circuit-breaker panels through insulated wooden rods.

In addition to the special high voltage d–c. panels, switchboards are also being furnished for the synchronous motors and auxiliary circuits. Oil switches and other standard 100,000-volt equipment are also being installed for the high-tension circuits.

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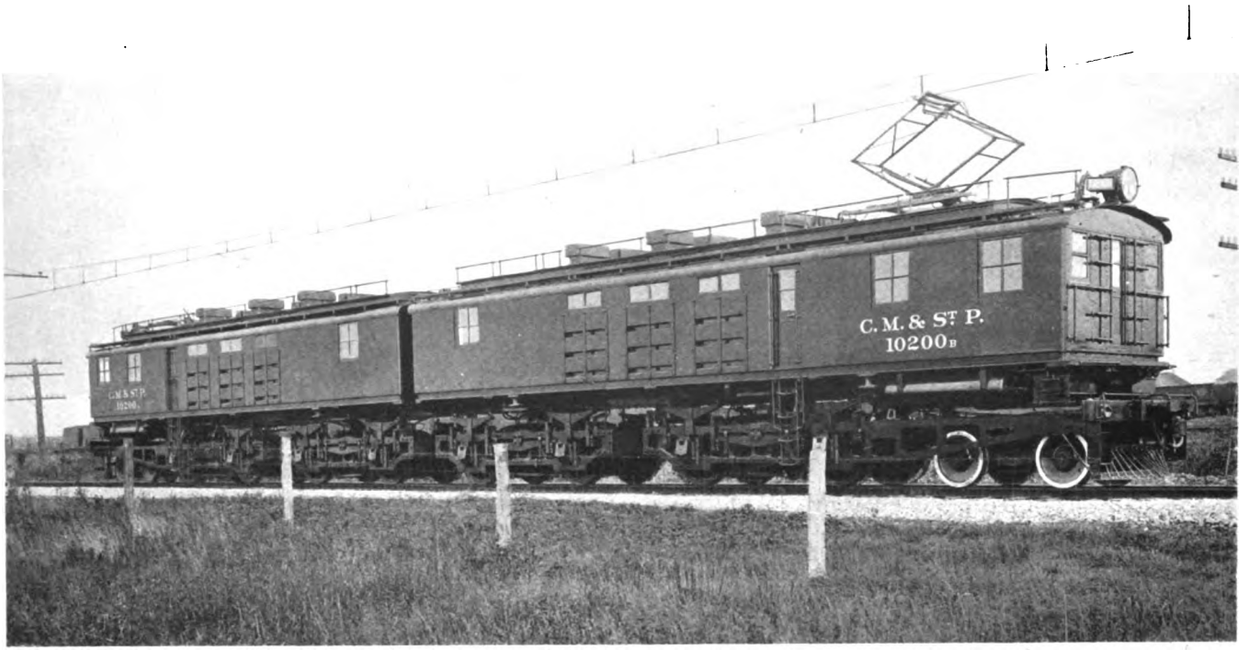
The transformers, which are under construction in the Pittsfield Works of the General Electric Company, are an example of the most recent design and construction. There are a total of 32 of these units, which are to be used for stepping down the power supply from the 100,000-volt transmission line to 3,200 volts as required for the synchronous motor-generator sets. These transformers will be installed in 14 sub-stations, which will furnish power for the entire electrification from Harlowton, Montana, to Avery, Idaho. There are twenty-three 2,500 kv-a. and nine 1,900 kv-a. units, located as shown in the accompanying table.

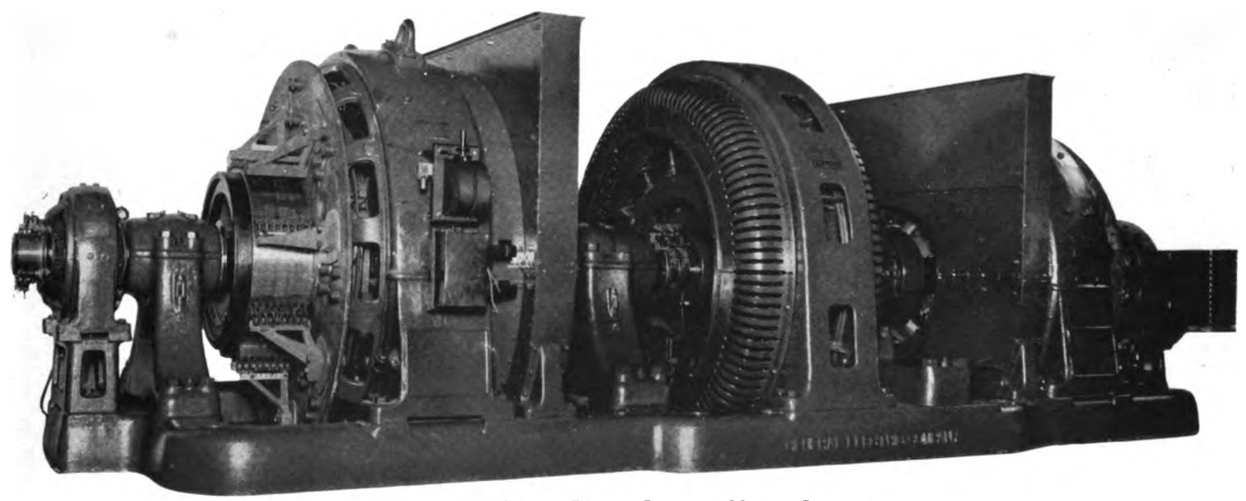
These transformers are all of the 3-phase core type, with a ratio of voltages of 102,000 to 2,300. For regulating purposes, taps are provided for 97,200 volts and 94,200 volts. Taps are also brought out on the secondary windings to give 1,150 volts or half voltage for starting the motor-generator sets.

The transformers are oil cooled and the tanks are of the tubular type, the main body consisting of steel plate with tubes welded to the side of the tank at the top and bottom, giving absolutely oil-tight joints. An air dryer and breather is attached to the tank, so that all interchange of air between the interior of the tank and the outside must take place through this channel. This dryer is provided with chambers containing a moisture-extracting medium, thereby preventing the entrance of moisture to the tank.



280-Ton 3,000-Volt Direct Current Locomotive—One of 42.

The bushings furnished with these transformers are weatherproof, and as all joints are tight they are suitable for outdoor as well as indoor operation. At the top of the high tension oil-filled leads is a glass cup, which shows the height of oil in the leads. Accessories, consisting of thermometer, oil gauge, and drain valve are also provided. Each transformer is mounted on flat wheels to facilitate movement for making repairs, and a lifting device is furnished for removing the transformer core.



2,000-kw. 3,000-Volt Direct Current Motor Generator.

In addition to the main transformer equipment, each sub-station will be furnished with a standard 10-kw. 3-phase transformer, stepping down from 2,300 to 110 volts for lighting and auxiliary power circuits.

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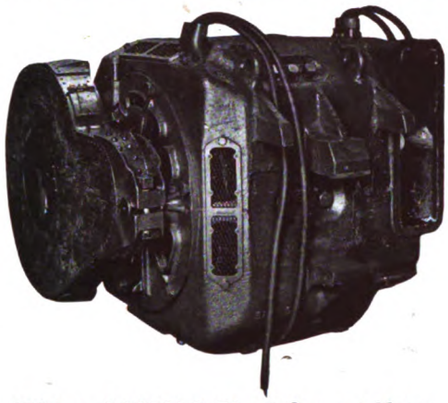
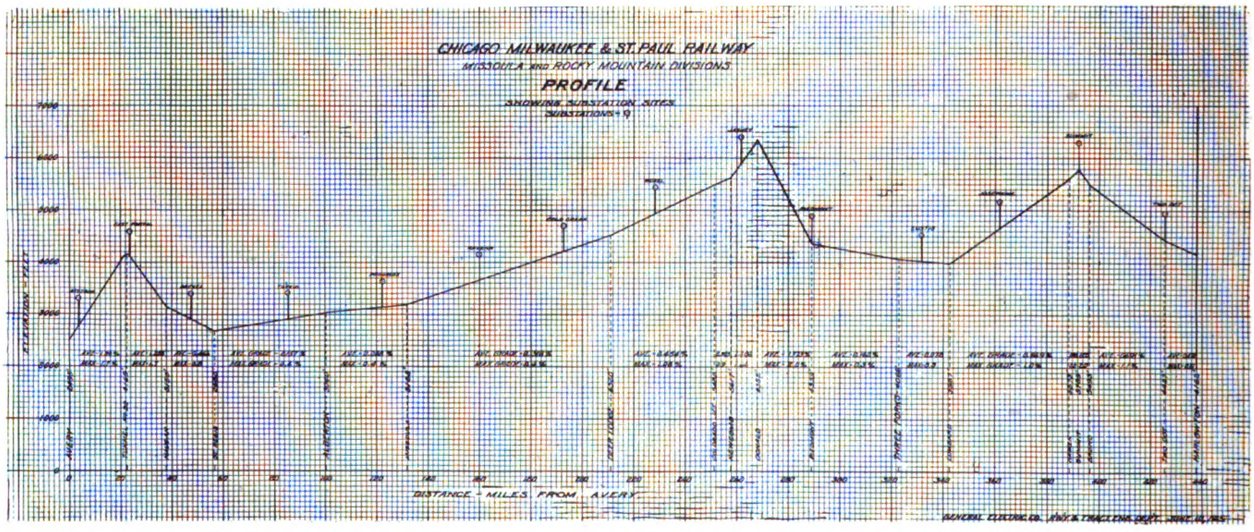
For operating the railway signal circuits, a standard 25-KW. single-phase transformer is being installed in each sub-station, stepping up from 2,300 to 4,400 volts. A portable oil-drying outfit will be used for removing moisture from the transformer oil. This outfit consists of a motor-driven pump which forces the oil through an especially designed filter and the electric drying oven for drying the filter paper. A portable transformer dryer and an oil-testing set will also be supplied.

The construction of the forty-two 282-ton electric locomotives is progressing rapidly at the Erie Works of the General Electric Company and in the Schenectady plant of the American Locomotive Company. The first complete locomotive was placed on the test tracks early in September and shipment was made as scheduled on September 25. This locomotive has been taken in charge by the railway company at Chicago and is now being exhibited at various points on the Chicago, Milwaukee and St. Paul system under the direction of Mr. C. A. Goodnow, assistant to the president. A complete set of tests indicate that the locomotive will easily exceed the expectations of the designers.



430-h.p. 3,000-Volt Direct Current Motor.

Twelve of the locomotives on order are geared for passenger service and the remaining 30 for freight service. Both freight and passenger types are equipped for regenerative braking, this apparatus being under control of the engineer. All of the passenger locomotives and several of the freight locomotives will be equipped with oil-fired steam boilers for heating the passenger trains. This equipment will include ample storage tanks for oil and water.



Gradients of Electrified Section of Chicago, Milwaukee, and St. Paul Railway.

The actual weights of the completed freight unit are as follow :—

Total	564,000 lb.
Weight on drivers	448,000 lb.
Weight per driving axle	56,000 lb.
Weight per guiding axle	29,000 lb.

MANCHESTER TRAMWAYS.

Hyde Road Car Shed Extension and New Stores. Ten and a Half Acres under Cover.

The extension of the Hyde Road car shed and the new stores that have been erected on an adjoining site were formally opened by the Lord Mayor of Manchester, on October 26. The new premises comprise the shaded portions of the accompanying ground plan. The proposal to acquire the Hyde Road site for a car shed and car repairing and building works came before the Tramways committee in 1901. The Queen's Road car shed was in process of erection, and the committee were looking around for a suitable site for a second depot. A number of alternative sites were considered, but the committee having an offer of a piece of land at the corner of Hyde Road and Devonshire Street decided, on the advice of the general manager, Mr. J. M. McElroy, upon that site as being the most suitable for the purpose.

The total area of land acquired was 12¼ acres. Plans were prepared for the erection of a car shed, and the work was commenced in July, 1902. This portion of the shed was completed in January, 1904, accommodation being provided for 265 cars, besides offices, men's mess and recreation rooms, boiler house, emergency wagon house, etc.

In December, 1904, a further portion (about four acres) of the land purchased was utilised for the erection of the car building and repairing works, including wood working, cabinet making, painting, electrical and other workshops, together with timber stores and additional boiler house. These works were opened by the then Lord Mayor (Sir T. T. Shann) in October, 1905. At that time the Tramways Committee considered that the buildings, comprising the car repairing, etc., shop, would provide for many years' requirements, but in 1913 the department found it necessary to roof over the open avenue (420 ft. long by 50 ft. wide) between the wood working and the mechanical shops, and it now forms part of the entire workshops.

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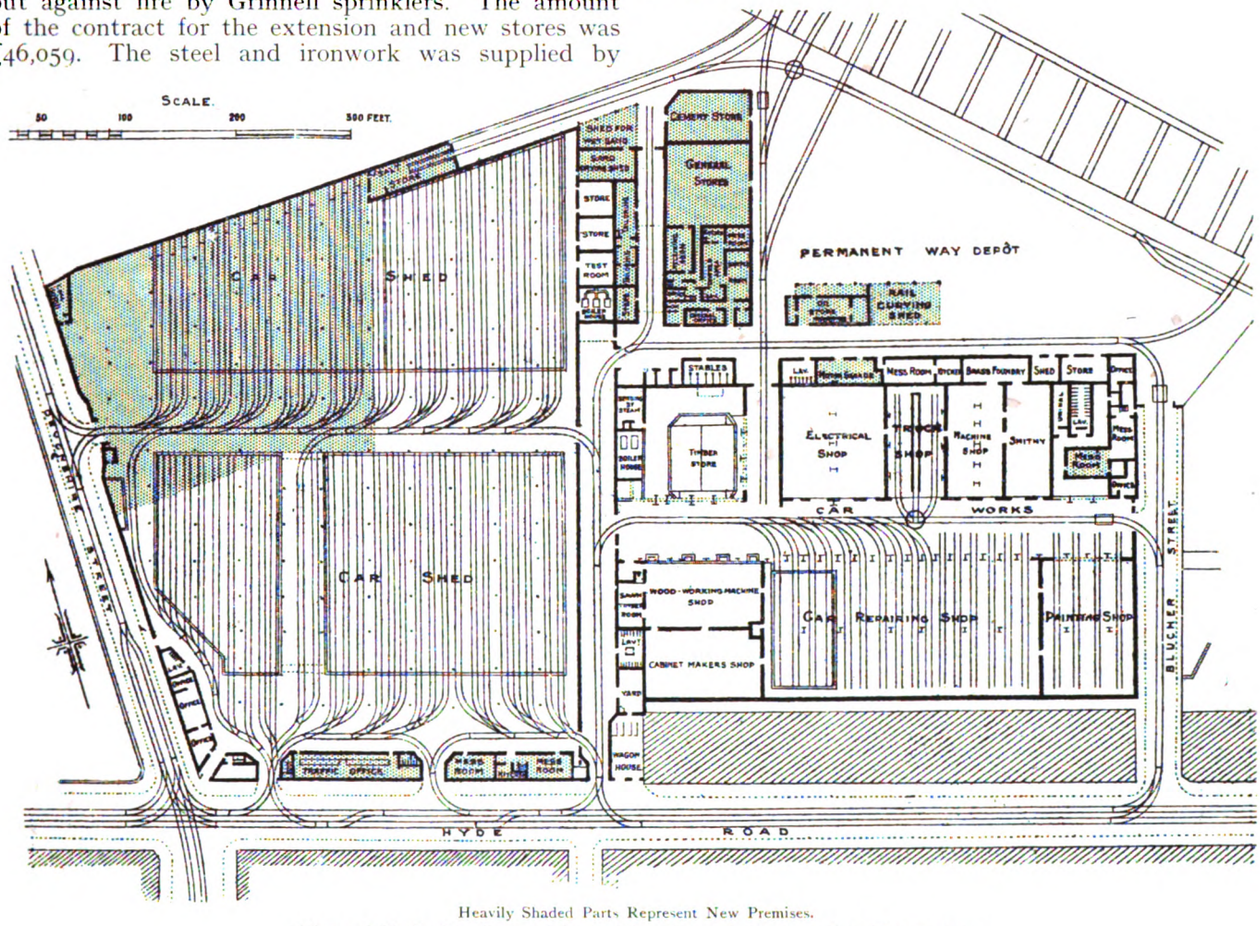
The further extension of the shed and the erection of new stores, formally opened on October 26, were begun in April, 1914, and comprise additional shed accommodation near the Devonshire Street end for 90 cars (making a total capacity at the present time of 355 cars; a three-storey building (200 ft. long and 80 ft. wide) for the storage of the large quantities of materials and equipmnet required to be kept in stock, sand drying shed, oil and paint stores, rail curving shed, tailoring stores and other buildings. The existing buildings fronting Hyde Road are at the present time being remodelled and altered to provide a large traffic office, men's mess and recreation rooms to meet increased requirements.

The total area of the sheds and buildings covered by roofs is 10½ acres. The premises are protected throughout against fire by Grinnell sprinklers. The amount of the contract for the extension and new stores was £46,059. The steel and ironwork was supplied by Messrs. Edward Wood & Co., and the general builders' work was carried out by Mr. Robert Carlyle. The architect was Mr. J. Gibbons, who has also been architect for the other car sheds of the department. The total cost of the land and buildings (including extension and new stores) was £277,000. It is of interest to note that the total number of men employed in normal times at the Hyde Road premises is 1,050.



Heavily Shaded Parts Represent New Premises.

Plan of Hyde Road Car Shed—Manchester Corporation Tramways.

The Lord Mayor (Alderman McCabe), in declaring the new buildings open, remarked that at the time the City Council purchased the Hyde Road site they were held up to ridicule for doing so. Manchester's development of its tramways was one of the most remarkable of municipal enterprises in the United Kingdom. He believed that the development had not yet reached its fullest extent; he hoped to see excursions by electric car to beauty spots in the district.

In presenting a gold key of the building to the Lord Mayor, Alderman J. Bowes, chairman of the Tramways Committee, alluded to Alderman McCabe as having laid the foundation of the tramways organisation during his former membership of the committee.

A presentation was made to Alderman Bowes from the members of the Tramways Committee to mark his 25 years' membership of the Corporation and his eight years' service as chairman of the Tramways Committee. The gift took the form of a splendid set of silver plate. Congratulatory observations were made by Councillor T. R. Day, Councillor R. Turner, and Alderman R. Wilson. Alderman Bowes, in reply, said the war had hindered further developments of the tramways. Under the united guidance of the Tramways Committee, aided by their general manager, Mr. McElroy, whose ability was second to none, great progress had been made.

The thanks of the gathering were accorded to Alderman Dr. Chapman for his services as deputy chairman of the committee during the past municipal year. In reply, he referred to the impressment of some of the committee's motor chassis by the military authority, and expressed his opinion that the traffic problem of the future would be between omnibuses and tramcars. Highly appreciative references were made by several speakers to the work of Mr. J. M. McElroy, the general manager, and Mr. J. Gibbons, the architect. In acknowledging the observations, Mr. McElroy remarked that at the age of 30 he was appointed secretary of the Tramways Committee and began that service with an office boy. To-day he had a staff of over 5,000. The Tramways Committee had greater problems to deal with in the future, for they were beginning a new epoch in the methods of transit, although the war had stopped development in that direction for the time being.

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Underground Railway Traffic.

Since an early period in the war the London underground railway companies, as other railway companies of the country, ceased publishing their weekly traffic receipts. It has thus not been possible to judge from week to week as in peace time how the volume of traffics fluctuates and how it compares with corresponding weeks of the preceding year. It is well enough known that the railway companies of the country generally continue to be excessively busy, both with passenger and goods traffic, as the demands of the Government, in addition to the ordinary requirements of the public, are very large. The circumstances of the London underground railways, however, are different from those of the other railways of the country. Not only are they for the most part underground, but each one is comparatively short, the traffic is confined to passengers, and the stations are very close together. They appear to have done a very fair business during the first year or so of the war. But a change, and one decidedly for the better, began to show itself in the autumn, and we believe that the number of passengers which these lines are now carrying is unprecedented. At all events, the volume of the business is enormous, as anyone who travels on the underground railways, especially during the busy hours, can see for himself. On the Metropolitan District Railway in particular the task of transporting the people without delaying anyone at times almost reaches the impossible. Nor is it the case that the frequency of the train services has been reduced. On the contrary, despite the number of employees who have enlisted, it has been found possible to run trains as frequently as ever. Indeed, they are often more frequent, and on the busiest sections during the "rush hours" it would be almost impossible to put on more trains. On the main line of the Metropolitan District Railway, between the Mansion House and Gloucester Road, there are in the mornings and evenings no fewer than 50 trains an hour in each direction. The trains consist of from six to eight cars each, and sometimes of ten cars each. The latter is the greatest number which can be used as a train, because the length of the station platforms is limited. On the main line of the Charing Cross, Euston and Hampstead Railway the maximum service is 46 trains an hour each way, the trains consisting of either five or six cars each. Similar figures could be advanced for the other lines. Such services, of course, are only possible by the use of electric traction with multiple-unit control, and of the complete system of automatic signalling which is employed on these railways.

* * *

As to the causes of this abnormal traffic, one, which has, however, been operative since the early days of the war, is the reduction of the number of omnibuses on the streets owing to the War Office demands for the use of vehicles of that type. Then the advent of the longer nights, coupled with the reduced public lighting, has encouraged people to travel underground. No relief from the darkness of the streets is found by making use of tramcars or omnibuses, because these vehicles are so dimly lighted that it is impossible to read in them. But the underground railway carriages are well lighted, and the passenger can read his newspaper at ease. The number of passengers is doubtless increased by the fact that a large proportion of the working classes are earning unprecedented wages, and so can afford to do more local travelling. Soldiers in uniform move about in

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such numbers that they now form a very appreciable percentage of the passengers. Moreover, when they are coming from or going to the country reduced fare tickets can be obtained by them to include a London underground railway journey. While the railways are doing this large business, it must not be supposed that their net profits increase correspondingly. The enormous price of coal and other railway necessities, the war bonus additions to wages of employees, and the general higher cost of everything must cause a very large increase in working expenses. The companies may be congratulated if their extra revenues balance the increased cost of operation.

Facing the Inevitable.

Events have made rapid progress since the annual congress of the Tramways and Light Railways Association in July last asked for skilled men in power-stations to be exempted from service in the forces, but refused to include car employees in the request. To the benefit of the industry and the nation generally the recruiting campaign of the past two months, arranged on clearly-defined lines as to enlistment and training, renders the outlook more certain than it has been for many months. Skilled men in tramways undertakings were given the option of being attested and passed into the Army Reserve, and they will not be called up for service unless their employer states that their services can be spared. Motormen may certainly be placed in this category, and whether the voluntary system continues or compulsion is introduced, there is reason to hope that the eligible men amongst them may never be called upon to redeem their promise. In that event the tramways manager will not have to plead before the local tribunal to be allowed to retain them as indispensable to the transport of munition workers and of others engaged in pursuits of importance to the national welfare. If the military outlook should undergo an unexpected change, and eligible motormen over and above those necessary for the workpeople's cars are called to the colours, the position will be serious for those undertakings that have not taken steps to provide men to fill the vacancies. Already these vacant positions are not inconsiderable in number where employees have preferred at once to answer the King's appeal. Judging by the experience of managers, no men are obtainable under ordinary labour conditions from among those who are above military age, and from what has been done at Newcastle and Birmingham it is evident that such aid can only be looked for in response to an appeal for volunteer workers. They are men who have time to spare early in the morning or in the evening, and the value of their services is not detracted from because some of them are glad to receive payment, while others, more fortunately circumstanced, devote the money to charities. Bradford is the latest place where the management have decided to adopt this expedient, provided the men who offer their services are considered fit to undertake driving on routes that with one exception have steep gradients. When that point has been demonstrated, women are to be trained to undertake the work of conductors. It is because of the difficulties of its routes that Bradford is the last of the tramways undertakings to adopt female labour, but the experience of Sheffield and one or two other places encourages the hope that women conductors may be equally as successful in the textile city. Elsewhere we give the full text of the considerations upon which Mr. C. J. Spencer bases his recommendations ; the document cannot but be helpful to such committees as have not gone fully into the question of additional motormen.

CONVEYANCE OF MUNITION WORKERS.

Mr. Barnes, Labour Member for the Blackfriars Division of Glasgow, asked the Minister of Munitions in the House of Commons on November 30 if his attention had been called to the lack of facilities for men getting to and from work at munition factories ; was he aware that from six to seven o'clock in the mornings there was a scramble in London for tramcars, with risk to life and limb ; had he considered the advisability of using motor transport cars to ease the congestion, and was he aware that there were plenty of A.S.C. unused motor vehicles ; and that on the Clyde there was the same lack of service from Glasgow and intermediate places, and that men lost time and wages as a consequence of late cars and trains?

Dr. Addison (Parliamentary Secretary to the Munitions Department) replied :—The Minister of Munitions is aware that the unsatisfactory conditions to which the hon. Member refers prevail in some places. At Woolwich some improvement has already been made in tramway and ferry services, but further improvement is needed. The question is being actively considered by a number of experts on transport questions, but the problem is a difficult one. I will see that the suggestion as to the use of transport cars is considered.

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BRADFORD TRAMWAYS AND LABOUR SHORTAGE.

REPORT OF THE GENERAL MANAGER AS TO DIFFICULTIES OF MAINTAINING THE SERVICE.

On November 22, Mr. C. J. Spencer, general manager, Bradford Corporation Tramways, presented the following report to the Tramways Committee :—

From time to time I have reported to the Tramways Committee regarding the question as to the difficulties of maintaining the tramway services on account of shortage of labour, and have had several conferences with the representatives of the men. As a result of these conferences every effort has been made to induce suitable men to apply for tramway service, and at one time the result of these efforts appeared to be very gratifying, and were of such a nature as gave promise of removing any further serious difficulties. In consequence, however, of the very great recruiting effort, and for other reasons mentioned later in this report, the position of affairs has again become critical, and of such a nature that immediate consideration and action in my opinion is necessary to avoid serious consequences.

In summary the position amounts to this :—The available supply of men is now near the point when it will be less than the steady loss. Taking a period of two months from September 10 to November 10, this year, the following figures are interesting. During this period 675 men applied for situations of all sorts in connection with the tramway service ; 206 of these were considered on first examination as acceptable for conductors. I must here state that the ordinary standards as to height, age, etc., have been as far as possible relaxed. No man who could usefully serve us has been rejected. Of this number, 86 were submitted to medical examination, with the result that we were left with 63 men, or 73 per cent. ready for training. Twenty-four per cent. of the number of applicants declined to take up duties for private reasons.

The result was that out of the total number of 675 applicants, 115 ultimately passed into the service of the department, and the balance had their names entered on the reserve list as available as soon as required. In the same period we have lost 109 men in enlistments or for other reasons.

From the above it will be seen that the relation of input to output is such that any extraordinary circumstance would very seriously affect the department. This extraordinary circumstance seems to be now imminent, judging by the remarks of responsible Ministers in Parliament and the great efforts that are being made in recruiting. The recruiting effort is having a dual effect upon us. First, it is naturally attracting men from the service into the army, and secondly, it is preventing influx into the department, and as these efforts become more strenuous, as they are almost certain to do, or if conscription, even in a modified form, is adopted, then it seems to me impossible to continue the present service of cars, unless some drastic alterations are made in our general organisation and methods. The above opinions have been gradually arrived at after full consultation with everyone I could think of, including the committee and our own employees, and I anticipate that there will be no great difference of opinion between myself and the representatives of the employees as to the position of affairs.

It may now be well to consider how a great recruiting effort is likely to affect us. (1) We should be directly affected by losing men necessary to run, clean, and maintain the cars, and (2) we should be greatly affected financially, due to the increased amounts payable for separation allowances under the resolution of the Council.

Dealing with No. 1.

We have in the department 1,281 employees, and this number is absolutely necessary to maintain the present service, apart from overtime. Of this total, 818, or 64 per cent. of the men are of military age, and I assume of fitness, and of that number 151 are unmarried. Under Lord Derby's scheme these men will be called up in classes, the single and the younger men first, and I think it would be no exaggeration to assume that we may reasonably expect that a call of 100 or 200 men in a batch is not impossible, and obviously from the figures above quoted, we are not in a position to replace men quickly, or even at all, when called up in their order.

It is within the knowledge of the committee that certain arrangements have been made between the Recruiting Officer and ourselves, as to the enlistment of tramwaymen, and I herewith beg to repeat this arrangement. The following letter was received from the Recruiting Officer :—

Bradford Recruiting Headquarters,
Labour Exchange,
Bradford, January 15, 1915.

General Manager,
Bradford City Tramways.

Dear Sir,—War Office instructions are that no men employed by Corporations in their tramways, electric light, and gas undertakings are to be enlisted unless they produce a certificate that their services can be spared, or that their services can be undertaken by men not fit for military service. You will be quite in order in issuing a notice to your employees as above.

Yours faithfully,
(Signed) S. C. BURTON (Captain),
Recruiting Officer, Bradford.

This has been acted upon up to the present with a slight modification. An alteration has now come about, viz., that all men, no matter whether they are employed on tramways or otherwise, who apply to enter His Majesty's service are attested and placed on reserve, and an undertaking is given that they will not be called up until it is found necessary, and it will be open for the Corporation to enter objections to certain men being taken, before a tribunal with whom a decision will rest.

The practice of the department up to now has been to give permits for enlisting to all men whose labour could be conceivably displaced by non-military labour, that is to say, that no clerks, conductors, cleaners, parcel employees, etc., have been refused permission to enlist, but some car drivers and sundry skilled employees have been refused, or at any rate have been asked to consider themselves for the moment on the consideration list, and the promise given that so soon as it was possible to relieve them that would be done.

Since the last order from the Recruiting Officer, these men have been informed that they may become attested and remain on the reserve list.

(2) We should be greatly affected financially due to the increased amounts payable for separation allowances under the resolution of the Council

At the present time tramway employees have been granted leave of absence, and their dependents are receiving allowances on the scale set out by the City Council. This is costing the department, in round figures, £8,000 per annum. From the figures above quoted, it will be seen that this figure could very easily be multiplied by three in the event of a large proportion of military-age men in the service being called to the colours, so that the committee must consider their resources and their ability, or inability, to meet financial demands put upon them.

But in addition to the direct cost, another very serious cost is being felt in the department. The men who have enlisted, and a considerable proportion of the men who are possible candidates for enlistment represent the best men in the service. The quality of man which we have had perforce to accept for service is much below our usual standard, and consequently the value of his labour is considerably less than the value of the labour of the man we were accustomed to employ in peace time, and this is having a marked effect in the cost of operation.

The committee will have noticed that in the weekly return the consumption of power has increased considerably. Taking the figure at the end of October, the consumption was 1·946d. per car mile, whereas the corresponding date last year shows 1·842d. a difference of ·104d., or 5·7 per cent. As last year's bill for electric current amounted in round figures to £53,000, it will be seen that the cost of this inefficiency will amount to £3,000. The current is only one item of expenditure, and the effect is being felt in many other directions. Accidents have increased very considerably, partly due to new men, and partly due, I believe, to lighting restrictions, but whatever the cause the department is feeling the bad financial effects.

On the other hand, fortunately the revenue has kept up very well, so that at the end of October we were £8,330 in excess of the receipts for the same period last year. As to how long we can hope that revenue will keep at its present high level it is impossible to say, but it does seem to me that it would be foolish to estimate on the present basis of revenue.

Having now dealt with the position of affairs under two headings, namely, the impossibility of keeping the service going at all in the event of serious withdrawal of labour, and consequently the financial effect of this withdrawal under the present extraordinary circumstances, it seems to me to be desirable to consider means whereby the committee may be able to meet the difficulties of the situation.

CURTAILMENT OF SERVICE.

The curtailment of the service would undoubtedly temporarily meet the position of shortage of labour, but it is very obvious that it would be at the cost of great public inconvenience, and what appears to me to be even more important at this time, the serious upset to revenue.

In a communication from the Minister of Munitions to the Town Clerk of Bradford, the following paragraph appeared :—

I am to state that the Minister notes the resolution passed by the Management Committee of the Bradford National Munitions Factory and by the Bradford Munitions Committee, and is in agreement with these bodies in considering the maintenance of an adequate tramway service essential in the interests of munition workers.

It therefore seems that in the national interests a certain minimum service must under any circumstances be kept going, and what that minimum service is it is very difficult to say. It is common knowledge that at the present time, from early morning to 9 a.m., the cars are crowded to excess, and it seems to me a fair assumption that a fair proportion of the passengers who use the cars at these hours are persons engaged in the manufacture of munitions of war of some sort or another.

In order to meet this demand the department has to man and maintain 153 cars. From 9 a.m. up to 12 o'clock noon there is a lull, and whilst the service to-day is reduced very considerably in these hours, yet undoubtedly the earnings per car-mile show that in this period less cars even could be run, and yet to some

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extent the public demand could be met, but it is questionable whether any real benefit, either financial or otherwise, would accrue by reducing the service in these hours any further than at present. It will be understood that cars cannot be left standing in the streets, they must be driven to the various depots for shedding purposes, and by the time a man has attended to the various duties necessary to that operation the time is fast approaching when he is due out again for the mid-day heavy traffic. The traffic then remains from mid-day onwards to finishing at a fairly high level, and I see no possibility of withdrawing cars without causing serious public inconvenience after that time.

Recently, during the last six months, we have withdrawn cars from the service after 9 p.m., but the crowded condition of the cars even to-day after that hour show that this has been done at the expense of the travelling public. Of course we could stop at 9 p.m., but whatever is done in that respect only shuts down a proportion of the expense, roughly speaking, half of the expenses are still left. Interest and sinking fund and all the standing expenses remain just the same whether the cars run or not, and the effect of curtailment of service in any direction will have a bad effect upon the finances, but still, if this cannot be avoided, it will have to be endured. I suggest that if curtailment of the service is necessary, without seriously interfering with the munitions output, the Sunday service and the late cars at night may be considered, but even this may be against the interests of those munition factories which are working seven days per week, and day and night.

Replacement of Labour by Non-Military Labour.

To some extent this has already been done so far as office staff is concerned, and young ladies are now undertaking duties which in more normal times were undertaken by male labour. This arrangement has up to the present been attended with satisfactory results. Further, some men outside military age and fitness have been taken in as clerks, and found temporary employment for the period of the war. So far as the ordinary tramways staff, however, is concerned, very considerable difficulty has been experienced.

From a considerable number of experiments we have found a man over 40 years of age cannot undertake with anything like satisfactory results the duties of a conductor, and whilst we have not in any sense banned men who are 40 years of age for this employment, yet applicants have been few and far between who could be considered at all, and of the few whom we have provisionally accepted, they have turned out very unsatisfactory and have left the service as unable to do the work.

The department has accepted in accordance with the policy of the committee, men of military age for the position of conductors, and this has in some quarters given rise to rather severe criticism. Whilst I believe there is very good defence of the policy, that point hardly arises under the head of this report.

The alternative, therefore, appears to be female labour. Female conductors have been accepted in many towns, and according to the reports of the managers they have been satisfactory, but notwithstanding that I am bound to say that in looking into the peculiar conditions of Bradford, both tramways and otherwise, I should not willingly recommend the employment of female conductors. But what is the alternative? I am bound to confess that I see none excepting the one of very greatly curtailed services.

The position, however, so far as drivers are concerned, is very difficult. To my mind, the employment of females for driving is entirely out of the question, and impossible under any circumstances in Bradford. Men of mature years, and of non-military age, may possibly be trained to drive if they are available. I am bound to say, that up to the moment, we have not considered men of this age for drivers' positions, due to the fact that it has always been an understood thing that this is the line of promotion from conducting, but I can quite conceive a stress of circumstances rendering it necessary to employ men direct on to the driving platform who would not be suitable for conductors. Even if that is done, the number of applicants over 40 years of age, up to the present, has been so small as to make no very great difference in the position of affairs.

The retention of drivers, therefore, is an extremely important matter, and I have made great efforts, both on behalf of the Bradford Corporation, and as representing the Municipal Tramways Association, to get war badges for our drivers, in addition to other indispensable men on the system, but up to the present I have not been successful, and I am not very hopeful at the present time.

I think the attitude of the Government would be that not a single tramwayman must be prevented from recruiting if it is at all possible to replace his labour by non-military age labour.

The Birmingham and Newcastle Corporations have adopted a system of "Volunteers," that is to say, they have advertised for volunteers—professional men and others—to come forward and offer their services for driving the cars during the week-ends, etc., when the stress of traffic was heaviest, but at the present time it is too early to say whether the experiment has met with any success.

On the face of it volunteer labour it seems to me can only be considered as a last resource. Whilst not wanting to deprecate for a single moment the patriotism of men who are willing to sacrifice their spare time in the interests of the nation, at the present moment, yet very considerable and obvious difficulties will, I am sure, be experienced in properly controlling and handling volunteers of this description. Still, this is a point that we may have to consider, and it is here mentioned not in extension, but with the object of drawing the committee's attention to this possible source.

In conclusion, I beg to impress upon the committee the very great seriousness of this question, and the urgency of its consideration.

SUPPLEMENTARY REPORT.

On November 29 Mr. Spencer submitted the subjoined report to the Tramways Committee:—

At a special meeting of the Tramways Committee held on November 22 the following resolution was passed:—

That the general manager be requested to report on suggestions that arrangements be made for passengers to be required to purchase tickets before being allowed to board cars, and that steps be taken for obtaining a supply of men over 40 years of age.

Also that it be decided that no men of military age be provided with employment on the tramways unless they are unfit for Army service, with the exception of men attested under Lord Derby's scheme, in regard to whom it be decided that, any resolution of the Council to the contrary notwithstanding, such men on proceeding on service shall be regarded as having left the service of the Corporation.

The suggestion in this resolution is based upon an entirely new principle of tramway working, and is undoubtedly revolutionary in character, i.e., that whereas to-day the fare is collected from the passenger of the car by the conductor, under the suggested scheme the fare would be collected at a booking-office, and the conductor would simply be the receiver of a ticket. In order to consider a proposal of this sort it is necessary to go back to almost first principles of tramway operation. It is well to remember just what a tramway is, and in what sense it differs from a railway, where this system of booking-office payment is in vogue.

Legally, a tramcar is a "hackney carriage" plying for hire on the streets. Any person may hail a car wherever he may be, and pay for such hire on the car to the proper and duly authorised officer, and it is a statutory duty imposed on the tramway authority to accept a passenger under those conditions. (A slight modification of the above law recently took place in Bradford, whereby stopping places have become legalised, and now an intending passenger cannot legally demand that a car be stopped between the authorised stopping points.) The establishment of kiosks or booking-offices at all stopping places is, of course, out of all question, but if the system suggested is a feasible system, then it must be quite clear that a conductor must be entitled to refuse admission to a tramcar to any person who has not first received a ticket for his journey, but, unfortunately, that is contrary to tramway law, and cannot be enforced without an Act of Parliament.

If this is left as a voluntary matter, then, of course, some people may go to the trouble of buying tickets, but I think it may be taken as certain that the great majority will not do so, with the result that two systems of fare collection and organisation would be working side by side, with unnecessary duplication and waste.

In my opinion, the suggested system is unworkable, and would result in the employment of a larger staff instead of a smaller staff. Paris has been quoted as the place where this system is in operation. That, however, does not appear to be a statement of fact.

In Paris there is, or was, a system in operation designed to avoid the overcrowding of cars at various loading points. A prospective passenger may go to a kiosk, and in some cases an automatic machine, and take therefrom a numbered ticket, which gives him a right to a certain seat on the car.

When the car arrives, the conductor calls out these numbers, the owners of which are entitled to take their seats in that particular car. In fact, it is, to some extent, a system of reserved seats, but it has nothing whatever to do with fare collection. The conductor of the Paris tramcar, like the Bradford conductor, collects his fares from the passengers on the car.

Volunteer Labour.

In accordance with instructions I have given consideration to the question of volunteer labour. As reported by myself, the Birmingham and Newcastle Corporations have been doing something in this direction, and I have during the week personally visited the Birmingham system and interviewed the general manager (Mr. Alfred Baker), and my traffic superintendent (Mr. Stirk) has visited Newcastle and interviewed the general manager and traffic superintendent, and obtained certain particulars in reference thereto.

Birmingham Tramways.

The Birmingham Corporation issued an advertisement asking for professional men and others who had some spare time, especially at week ends, to volunteer for positions as auxiliary tramcar drivers, the accepted applicants to be trained for their duties, and when efficient would be paid at the ordinary rate for drivers. Applicants to be men of non-military age. Six hundred and sixty applications were received in response to the advertisement, two-thirds of which were from the artisan class, and one-third representing a mixed class, ranging from solicitors and accountants to shopkeepers and clerks. All the applicants were over military age, ranging from 42 to 50.

Before being accepted, each man was submitted to a medical examination, and if successful was sent to a departmental school of instruction, where he was instructed in all the detail matters relating to tramcar driving. After having taken the theoretical side of the work at the school, the men were then allowed to take

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driving lessons on the platform of the car with certain drivers. They were supplied with a special badge and certificate which they could show to the trainer driver, and were requested to take their practice on certain routes convenient to their homes at least four evenings per week continuously until required for regular duty, the scheme being adopted with the idea of keeping them in fit condition and acquiring that instinct which is necessary to successful operation.

Of the 660 men, 200 have passed through, and are now either at "school" or in practice. No trouble up to the present has been experienced, and Mr. Baker is very optimistic as to the result of this experiment. The class of man that has applied in the main is a very desirable class, and consists generally of men whose ordinary occupation does not demand too much of their time, and who are in the main desirous of increasing their income.

Undoubtedly the best and most suitable man comes from the artisan class, whose vocations are such that they are accustomed to an outdoor life, and are therefore hardy and strong. Nothing is paid for their training or practice, but the ordinary rate of pay is attached to the position when they are fulfilling the place of an ordinary motorman.

Newcastle Tramways.

The traffic superintendent reports that at Newcastle at the moment about 80 volunteers are engaged, some acting as drivers and some in the capacity of conductors. Up to recently these men have been employed working special cars in the morning, from 5 to 7.30, and in the afternoon from 4.30 to 6.0. Some alteration has very recently taken place, whereby the call upon volunteer labour has been somewhat lessened. The men who have been accepted are in good positions, mostly professional men. A large number of them are insurance agents who have their mornings and evenings at liberty. One volunteer driver is a bank manager, and another is a member of the Tramways Committee.

Mr. Hatton finds them very reliable, and they give little or no trouble to the management. It seems, however, that when asked to work after finishing the tea-time specials, they have refused to do so on the ground that they did not volunteer to meet the convenience of the Tramways department, so much as to enable the munition workers to be carried to and from the works.

The volunteers are paid the maximum rate of pay for drivers, and are supplied with a certain amount of uniform.

Two Suggestions.

Summing up the position, I am certainly attracted to the idea of voluntary labour on the lines indicated by Mr. Baker, of Birmingham, and whilst at the present moment we may not be in need of labour of this sort, it seems to me that it would be desirable to consider it for future use, and even at the present time we may avail ourselves of it for week-ends.

There is, however, one local circumstance which ought to be mentioned; with perhaps one small exception, we have no routes in Bradford that have not got steep gradients, and before being willing to accept men to drive on steep gradients, I am desirous of seeing the class of man who comes forward, and thus be able to form some idea of his fitness for the job. I see no harm, however, in issuing an advertisement somewhat similar to the one issued in Birmingham, and offering similar conditions.

On the question of female labour, the Birmingham Corporation have something like 800 female conductors, in addition to a number of female car cleaners. Mr. Baker expressed himself most enthusiastically in favour of both women conductors and cleaners. The duties undertaken by the women conductors are exactly the same as those undertaken by the men, and the same rate of pay and general conditions of service are attached to the position.

Mr. Hatton, of Newcastle, on the other hand, has a certain number of women conductors, and expresses himself as very disappointed with them. They have 180 women conductors, whose duties commence at 9.30 a.m. and they finish approximately at 6.0 p.m. The best he could say, however, of them was that they are a "make-shift."

I would again urge upon the committee the extreme seriousness of the position of the tramway system. There is a possibility of being so short of the necessary men to work the undertaking, that one of two alternatives must be adopted, viz.:—

(1) Curtailment of service.

(2) Employment of female labour.

As pointed out in my previous report, serious curtailment of service means great public inconvenience, with serious financial consequences, to say nothing of the necessity of keeping the tramways going in the interests of the nation.

I agree with many of the disadvantages that have been stated in connection with female employment, but we cannot forget that these objections will weigh lightly in the eyes of any tribunal, when it is remembered that the managers of at least a dozen large tramway systems are prepared to come forward to say that female labour on their particular systems has, from every point of view, been a success. An ounce of their practice will be considered to be worth a ton of our theory.

The difficulty under which I think we are all labouring at the present time is the necessity of changing one's point of view from day to day, according to altered conditions. In fact, it has now got to be a question of choosing between the evils, and it does appear to me that it is incumbent on the Tramways Department to at any rate make an experiment with women conductors before being forced into the alternative of curtailment of service.

It is possible that the local conditions of Bradford are such that women conductors would not be successful, but no one can say without a trial, and I suggest that the sooner the trial is made the better.

I therefore suggest to the Committee that instructions be issued to make arrangements at the Thornbury car depot and the Head Offices, at Hall Ings, for the accommodation of a certain number of women conductors, and that one or two routes be experimented with. The rate of wages and the hours of duty to be the same as male conductors, with the exception of longer meal reliefs. Further, that the necessary uniforms be purchased and other essential equipment for such operation be immediately put in hand.

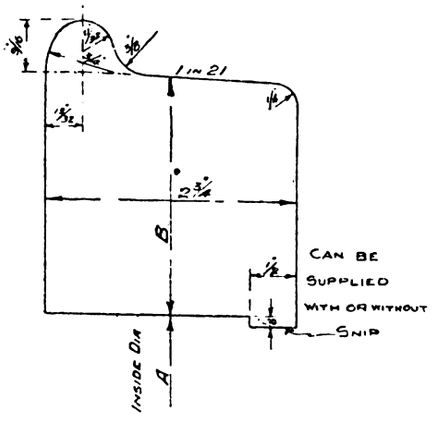
TRAMWAYS COMMITTEE'S DECISION.

The Tramways Committee considered the supplementary report at their meeting on November 30, when they decided in order to meet the difficulty of shortage of labour, to advertise for applicants ineligible for military service, and not over 50 years of age, to act as conductors. The committee also agreed to advertise for volunteer auxiliary drivers to be trained, in order that they may act as motormen during the rush hours of the day (in the mornings and evenings) and at week-ends.

TIRES TO BE STANDARDISED.

A meeting took place at Sheffield on November 24, between representatives of the two Tramway Associations and representatives of the leading steel tire manufacturers. Mr. F. Bland was in the chair. Those present were:—Municipal Tramways Association—Messrs. Fearnley, Clough, Spencer; Tramways and Light Railways Association—Messrs. H. England, Tippets, A. de Turckheim; Manufacturers—Messrs. Good (Cammell Laird and Company), Norton (Brown Bayleys Steel Works, Limited), Dalby (John Brown and Company), and Longden (H. Bessemer and Company).

The Secretaries of the two associations stated that in response to inquiries they had made amongst their respective members, the total requirements for one year amounted to about 24,000 driving and 10,000 pony tires. A considerable amount of these were actually on order and in stock. In order to assist deliveries it had been arranged that, with few exceptions, members would agree to standardisation of tires under three groups. This was accepted by the manufacturers, who then authorised the Secretaries to make an offer to their members for deliveries within stated periods at



Proposed Section of Standard Tire for Tramway Car Wheels.

stated prices. This offer is now being considered, each undertaking being at liberty individually to accept same as they may see fit.

The important decision recorded above was the result of preliminary investigations made by a sub-committee of each association with a view to ascertaining what steps could be taken to ensure a sufficiency of tires being obtained during the war. The Journal of the Tramways and Light Railways Association for November states that the sub-committee of the association agreed that the supply of tires would be facilitated by

(*a*) The adoption of a standard section, especially so far as the profile of the tread and the width are concerned, both in regard to driving and pony tires, as this would enable the manufacturers to (1) increase their output, (2) do away with the delay and expense that is necessarily incurred by changing rolls, and (3) maintain stocks.

(*b*) The preparation of a list showing the actual requirements of each undertaking and the name of the supplier.

With the form of inquiry sent to each member was the accompanying diagram of the proposed section of standard tire.

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DEVONPORT TRAMWAYS ARBITRATION.

At the Surveyors' Institution, Westminster, Mr. B. Hall Blyth sat as arbitrator from November 10 to November 23 to determine the price to be paid by the Plymouth Corporation for the purchase of the undertaking of the Devonport and District Tramways Company.

During the proceedings the parties came to agreements in the following sums for items that were formerly in dispute :—Stores, £2,800 ; depot and land, £9,500 ; improvements to roads, etc., £10,000 ; alterations to pipes, wires, etc., and post-office, £1,830 ; payments to Devonport Council, £1,334 ; cars, £12,000.

Mr. Macmillan, K.C., for the company, said the tramways, which were authorised in 1898, were practically 4⅝ miles in length. Devonport Corporation had constructed certain lines, and in 1898 induced the company to accept a lease for twelve years. The company found the terms unduly harsh, and sought relief from Parliament, but failed to obtain it. They braced themselves to the situation, and the result of their efforts and other fortunate circumstances were reflected in a very considerable measure of prosperity. A light railway order was obtained in 1905, which was intended to form a necessary link between the tramways in Devonport and Plymouth. It was not until the war that the line was ordered to be linked up under superior force. Counsel said he based his case on the principle laid down by the House of Lords in the Edinburgh claim, which had been accepted by every arbitration tribunal since. The company were entitled to such terms as fairly reflected their foresight and acumen in obtaining the through running powers. In the forefront of the argument of Plymouth in the amalgamation proceedings before Parliament was the absence of through running, the obstacle to which, it was represented, was the jealousy between the two Corporations.

Mr. Stephen Sellon, consulting engineer, was the chief witness in support of the company's case. He estimated the value of the permanent way at £60,161, and the rails at £13 14s. per ton. The cars were all in good condition, their value being £21,545. The Council had agreed to take over 33 cars and other rolling stock. Interest during construction had been claimed to the amount of £8,000. The value of the undertaking was £165,875. The amount for legal and Parliamentary expenses was £5,000. Dealing with the value to be placed upon expected profits, Mr. Sellon said that under the agreement which set up this arbitration the third article gave the company the right to such a sum as would be equal to the aggregate amount they might be expected to earn between October 2, 1915, and August 12, 1919. He submitted the following table :—

Year.	Car mileage.	Profit.
1912	687,791	£5,500
1913	703,061	6,079
1914	749,900	5,966
1915 (to Oct. 1)	581,730	8,624
	Car mileage (Estimated).	Profit (Estimated)
1915 (Oct. 2 to Dec. 31)	195,672	3,714
1916	812,994	15,931
1917	848,586	18,361
1918	884,178	21,164
1919 (to Aug. 12)	564,461	14,832

	£	£
Total profits October 2, 1915, to August 12, 1919	—	74,002
Deduct for loss on resale of three additional cars	300	—
Deduct depreciation October 2, 1915, to August 12, 1919	5,126	5,426
Total	—	68,576

The cross-examination of Mr. Sellon by Mr. Lloyd, K.C., was an attempt at showing that his figures as to future profits were inflated. Mr. Sellon admitted that his figures for rails were abnormal owing to the war, and he urged that the increase in traffic to the dockyard might prolong itself after the cessation of hostilities.

The Arbitrator stated that he would not allow anything like the claim of £730 per car.

Mr. Harry England, general manager, Yorkshire and West Riding Tramways and Wakefield and District Light Railway, gave evidence in support of the company's claim. His evidence and cross-examination occupied the greater part of two sittings. With respect to the expected profits between October 2, 1915, and August 12, 1919, he thought 10 per cent. was a reasonable increase to take. The longer the war lasted the busier Devonport would become, and the tramways would benefit. In 1918, if the tramways were carrying all the traffic he had forecasted, they would only be carrying the population of Devonport 116 times. In 1912 the estimated population was carried 70 times, in 1913, 72 times, and in 1914, 79 times. He estimated that the population would be carried 98 times in 1916, 107 times in 1917. The total profits, subject to depreciation for the period October 2, 1915, to August 12, 1919, he estimated at £67,829. The effect of through running would be very marked. His own tramways undertaking enjoyed through running with Leeds, to their mutual advantage. For Plymouth and Devonport he estimated the profit from through running for the period October 2, 1915, to August 12, 1919, at £17,598. The light railway he valued as the connecting link enabling through running to be put into operation. Its value was £10,000. The provision of interest during construction was essential.

In cross-examination, he did not know that the war activity at the docks was already subsiding, that workmen had been discharged in large numbers, or that the Government had given permission to recruit.

Mr. C. Braithwaite, a member of the Stock Exchange, gave his estimate of the amount it would have cost to float the undertaking on October 2 last.

Mr. Lloyd, in stating the case for Plymouth Corporation, said that in 1902 the company paid 4 per cent., and in 1904, when the extension had been opened, although that was the year in which the prosperity of Devonport was at its highest, the dividend fell to 2 per cent. Since 1904 it had disappeared. The light railway by itself would be useless. Mr. Lloyd presented the following table showing the items not agreed upon :—

	Corporation.	Mr. Sellon.	Mr. England.
	£	£	£
Permanent way	28,500	60,000	58,000
Overhead equipment	3,000	4,938	4,230
Cables, ducts, and manholes	5,300	7,950	7,797
Depot permanent way	1,000	1,809	2,028
Depot overhead equipment	135	285	256

In the Edinburgh and London decisions in the House of Lords the arbitrators never said they had taken the cost at the particular date of the notice or the valuation, or the probable transfer, but they took the " proper " costs, assuming that the tramway had not been constructed.

The Town Clerk, and Mr. W. Cash, an accountant, were called for the Corporation. The former stated that they were advised that by amalgamating the undertakings they could save £7,000. The peak of the war prosperity in the district had now been reached. He was convinced that the Corporation would not have granted through running powers to the company, as they did not trust them. Mr. Cash declared that the company had apparently shown an anxiety to relieve the charges upon revenue by placing them upon capital. The estimated net profits based on the company's forecast of earnings ranged from £12,261 for 1916 to £19,298 for 1918, allowing for dividends ranging from 9·2 to 14·5 per cent. The highest dividend he could find for any tramway company was 8½ per cent. In reply to a question by the arbitrator whether, supposing he adopted Mr. Sellon's figures, it would bring into operation the excess profits tax, Mr. Cash gave an affirmative answer.

The chief expert witness for the Corporation was Mr. J. B. Hamilton, general manager to Leeds Corporation Tramways. Mr. Hamilton said he valued the rails at £8 5s. per ton, as it was difficult now to obtain quotations. He estimated the average life of the tramways at about 21 years, assuming the present traffic conditions continued. The granite setts he valued at £1,497, after allowing for re-dressing those that were suitable when the rails were worn out. The setts were not first-class when originally laid, and were irregular as to size. He gave no residual value to the standards ; the whole of the worth went in the endeavour to recover them. Their life he put at thirty years. His figures for the trolley wires were higher than those of Messrs. Sellon and England. It was impossible now to obtain copper except on a certificate of the Minister of Munitions. Certain money had been spent in a particular way on the cars which did not do them much good but made them look better. That money had been charged to capital. As to future profits, he did not think that the year 1915 would repeat itself ; the earnings would be on the downward grade in 1916. No value could be attached to the light railway without through running.

Cross-examined, Mr. Hamilton said the reason he did not allow even scrap metal value for the standards was because it would be more than exceeded by the cost of removal. The condition of employment at the Dockyard was in a peculiar degree an important factor of the traffic. Employment was declining now. The period of higher revenues would continue for a year after the war, and after that there would be an immediate drop. He did not think that the company made the profit of £6,079 in 1913 as referred to by Mr. England.

Mr. Macmillan said he would not cross-examine on the light railway, as the arbitrator was to place his own figure upon it.

Mr. A. Body, surveyor, who had valued the tramways for assessment, said the assessment now in force was made in 1906. The assessment since 1906 had been £1,934. The net rateable value on his valuation on the accepted basis was £5,185 for the year ending October 1, 1916. Witness calculated that if through running had the results contemplated by Mr. England, it would mean an addition in respect of rates of £4,525.

The hearing was adjourned until December 15.

Effect of the War on Australian Construction.—Prior to the war Prahan and Malvern (Victoria) Tramways Trust proposed to carry out extensions extending to about 22 miles, but they have now informed the various local authorities that they are of opinion that no scheme beyond the one already arranged for should be entertained until normal conditions return. The Trust further state that the construction cost per mile of double track rose from £11,300 per mile in 1912 to £12,500 in 1914, before the outbreak of war. The cost at present would probably be £14,000. The only proposal which the Trust countenance is for a line of one mile in Malvern, which would cost about £14,500.

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WOMEN CONDUCTORS IN LONDON.

London County Council, on November 23, discussed the Highways Committee's recommendations, given below, for the employment of women as conductors on the Council's tramcars :—

That the employment of women conductors on the Council's tramcars be authorised during the period of the war and thereafter so long as conditions are abnormal; that women conductors be paid proportionately to the time worked at a rate equivalent to the daily rate of pay of male conductors; and that their other conditions of employment be generally similar to those of male conductors.

That tenders be invited from selected firms for the provision at Balham car shed of lavatory, etc., accommodation for women conductors.

That women be employed at the central car repair depot on work of an unskilled character in connection with the repair of tramcars; that their commencing rate of pay be fixed at 20s. a week; and that their hours of labour be 48 per week.

The Conciliation Board scheme is to apply to these women. With regard to their rates of pay, the Committee stated that as far as possible women would be engaged for full time employment, and would then be paid at the same rate as male conductors. There might, however, be exceptional cases in which a long spread-over occurred, and one woman could hardly be expected to perform the full duty. It would probably be found convenient in these cases for one woman to take the early morning duty and another woman to take the late evening duty, the full day's pay being divided. The precise conditions could only be settled after some experience had been gained, and after it was seen how many men would be called up for service under the group system of Lord Derby's recruiting scheme.

Mr. H. Gosling moved the reference back of the reports on the ground that these half-time proposals meant half-money. Women should have the same pay as men, which was a minimum of 5s. a day.

After a discussion, Captain Prestige (vice-chairman of the committee), endeavouring to meet the wishes of the Council, said that the committee would not employ any woman for the present who was not prepared to work full time. The object of the report was really to study the convenience of the women themselves. If the women found that their spread-over work was more than they could do, the matter would have to go to the Conciliation Board with a request to devise a half-time scheme.

The amendment was withdrawn, and the Committee's recommendations agreed to.

Women conductors made their appearance on the cars of the London United Tramways Company early in November, and they were to be seen on the motor-omnibuses of Thomas Tilling, Limited, on November 2. Twelve women were at work on the Ilford Council cars in the third week in November. Mr. L. E. Harvey, the tramways manager, states that they were doing the full work on one particular route, working a split shift of two periods of approximately four hours each, with a rest of two hours between. They worked the workmen's cars, starting at 4.40 a.m., and also the late cars. Their uniform consists of a khaki tunic and skirt, overcoat, gaiters, and hat. The garments throughout are piped with scarlet. The hat is a soft felt one, and has a one-inch scarlet band round it made of enamelled leather with buckle. Under the shoulder-straps of the tunic and overcoat are pieces of brown basel leather to prevent the punch strap wearing the cloth; there are brown basel leather cuffs for the garments, and the edge of the skirt has a band of the same leather. The skirt is about eight inches from the ground, and the gaiters are twelve inches long. Croydon, Bexley, and West Ham tramway authorities and the Metropolitan Electric Tramways Company have also found themselves obliged to employ female conductors owing to the shortage of men.

WINTER UNIFORMS FOR WOMEN.

Glasgow Tramways Committee have considered the question of providing women conductors with overcoats, mittens, and other warm clothing during the winter. The women who are being experimentally trained as drivers have the advantage of working cars with vestibule ends, and of wearing Canadian gloves. There is a difficulty in supplying the conductors with gloves, but some of them have obtained soiled kid gloves in the shops. Mr. Dalrymple announced on November 25 that the committee had decided to at once issue cardigan jackets, to be worn under the tunic, and gaiters.

On the Metropolitan Electric Tramway cars the women wear skirts ten inches off the ground, and long laced gaiters. The three-quarter length navy blue overcoats are lined with flannel. Their hats are of shiny black waterproof material, with badge in front.

At Bath the girls acting as conductors wear short-cut skirts and long gaiters, while for wet weather they are supplied with a long mackintosh.

The Experiment of Women Drivers at Glasgow.—A protest against employing women as drivers of tramcars has been forwarded to the Corporation by the Trades Council. So far the Tramways Committee have not made any recommendation in favour of women being thus employed. It is worthy of note that the women under instruction are now undergoing a further course of training, although they have completed the term for which men are instructed before being placed in charge of a car. Since November 28 the six women have been driving cars in a service run from the Coplawhill depot.

FINANCIAL REPORTS AND MEETINGS.

Electric Construction Company.—A dividend at the rate of 7 per cent. per annum on preference shares for the half-year has been paid.

Illinois Traction Company.—The directors recommend a dividend at the rate of 3 per cent. per annum on the common stock for the quarter ended October 31.

City of Buenos Ayres Tramway Company.—The directors announce a dividend of 1s. 3d. per share (5 per cent. per annum) for the three months ended September 30.

Vera Cruz Electric Light, Power, and Traction Company.—The net profits for 1914, after providing for debenture interest, were £1,020, and the sum brought forward was increased to £14,017, which the directors propose to carry to the new account.

Buenos Ayres Port and City Tramways Company.—The accounts for the period from December 31 to June 18, when a receiver was appointed, show profits of £6,191, and debenture interest requires £13,781, sinking fund charges £2,592, and interest on loans £2,340.

United Electric Tramways Company of Caracas.—The profits for the twelve months ended June 30, including £1,207 brought forward, were £15,750. A dividend of 7 per cent. and a bonus of 1½ per cent. are proposed, carrying forward £1,299. The report states that the profits had been adversely affected by the war. The percentage of operating expenses is 51·38, which is 3·10 per cent. more than the previous year, due to the larger mileage run with less receipts.

Morecambe Tramways Company.—The 29th annual report shows that the gross receipts were £2,860, and the working expenses £1,712. The balance of revenue account, together with the amount brought forward, amounts to £1,226, which the directors recommend should be dealt with as follows :—Dividend at 2 per cent., £330; depreciation of rolling stock, £360; depreciation of track, £150; write off cost of Act of 1910, £100; carrying to next account, £285.

Norwich Tramways Company.—At the annual meeting Mr. F. Fitzgerald said it was satisfactory that the company had been able to maintain their position. The directors and management had endeavoured to co-operate with the city authorities in these difficult times, and he congratulated the borough on the successful way they had dealt with the lighting problem. Twenty-two reservists and 71 volunteers from the tramway employees had answered the country's call, or 45 per cent. of the total employed.

York Corporation Tramways.—The gross profit for the past year was £8,471, as against £8,838 in the preceding year. Net profit was £1,211, as compared with £2,523. There was an increase of nearly £3,000 in the traffic revenue, and traffic expenses increased by £1,142, general repairs by £850, and electrical power by £744. The car-mileage was 765,698, as against 707,370. For the first year of the motor-omnibus service there was a loss of £4. Allowances to men on military service absorbed £9,110, or 0·29d. per car-mile.

Mexican Tramways Receivership.—At the request of the holders of large amounts of the bonds of the various companies constituting the Mexico Tramways, Light, and Power Group, the following gentlemen have consented to act as a committee to co-operate with the trustees, the receivers, and the boards of directors in taking such measures from time to time as will best safeguard the interests of the security holders :—Messrs. E. R. Peacock (chairman), S. Boulter, H. F. Chamen, R. Fleming, H. M. Hubbard, and A. F. P. Roger. Any communications should be addressed to Mr. T. Porter, secretary of the committee, 34, Bishopsgate, London, E.C.

Newport Corporation Tramways.—The annual report of Mr. N. J. Young, general manager, and Mr. A. Nichols Moore, borough electrical engineer of the Newport electricity and tramways department, shows a net balance from the electricity undertaking of £743. In 1913-14 there was a deficiency of £1,240. In the tramways department there is a balance of £2,417 after payment of all charges, including interest and sinking fund. In the previous year there was a deficiency of £2,616. The revenue of the tramways department for the year was £42,704, an increase of £1,513. Passengers increased by 254,753, but the car mileage decreased by 3,629. The total working expenses were £30,956, a decrease of £3,437. The sum of £506 was paid to tramway employees serving with the forces. The total revenue per car-mile amounted to 10·62d., and the total working expenses to 7·70d. The percentage of working expenses to total receipts was 72·49d.

Auckland Electric Tramways Company.—At the annual meeting held on November 8 in London, Mr. C. G. Tegetmeier (chairman) said this was the first time since the company started electrical running, in 1902, that they had not been able to point to an increase in the company's revenue over that of the preceding year; but the war had affected their business. The traffic receipts amounted to £267,793, a decrease of £3,908. The whole of this decrease, however, was in respect of the motor-omnibuses, the receipts from the tramways being a few hundred pounds more. The omnibuses were acquired for the purpose of facilitating the Exhibition traffic in the preceding year, and on the close of the exhibition their running was almost entirely discontinued. The board gave a donation of £1,000 to the Auckland Patriotic Fund. The balance available for distribution was £59,280, or £1,221 less. The dividend on the preference shares was unaltered at £9,000. They proposed to pay the same dividend of 1s. 7d. per share for the year on the ordinary shares,

(Continued on page 469.)

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COMPARATIVE ELECTRIC TRAMWAY ACCOUNTS

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Year Ended.	Electric Traction Inaugurated.	System.	Line open (single track). Mls.	Chs.	Borrowing Powers.	Borrowing Powers Exercised.	Unexhausted Borrowing Powers.	Total Capital Expenditure.	Capital Expenditure per Mile of Single Track.	Loans Outstanding.	Loans Repaid and Sinking Fund.	Depreciation, Renewal and Reserve Funds.	Gross Receipts. Traffic.	Other.	Total.
Aberdeen	*May 31, 1915	Dec., 1899	E.	27	56	415,000	366,332	48,668	366,332	13,225	184,118	234,194	189,803	86,614	1,388	88,002
Accrington	Mar. 31, 1914	Aug., 1907	,,	10	53	181,925	133,875	48,050	134,734	12,636	113,870	20,864	16,581	29,843	350	30,193
Ashton-u-Lyne	Mar. 25, 1914	Aug., 1902	,,	8	15	130,070	109,814	20,256	109,814	13,412	73,958	32,270	2,950	23,341	677	24,019
Ayr	*May 15, 1915	Sept., 1901	,,	9	30	128,000	98,630	29,369	100,705	10,742	78,770	27,866	17,649	17,181	804	17,985
Birmingham	Mar. 31, 1914	Jan., 1904	,,	114	44	2,577,611	2,352,104	225,507	2,334,437	20,379	1,915,559	438,545	186,154	628,016	7,455	635,471
Blackburn	*Mar. 25, 1915	Mar., 1899	,,	24	63	408,174	342,474	65,700	336,258	13,566	354,600	191,985	3,718	65,158	3,144	68,302
Blackpool	*Mar. 31, 1915	June, 1899	,,	(p)21	51	460,473	316,005	144,468	316,005	14,604	316,005	138,577	19,698	75,344	761	76,105
Bolton	*Mar. 31, 1915	Dec., 1899	,,	47	69	551,092	551,092	Nil	570,981	11,930	348,111	202,980	43,059	140,182	1,228	141,410
Bradford	*Mar. 31, 1915	July, 1898	,,	(h)118	9	1,280,788	1,043,788	237,000	1,043,054	8,831	634,618	439,321	75,208	309,320	20,568	329,888
Brighton	*Mar. 31, 1915	Nov., 1901	,,	17	15	378,093	279,978	98,115	280,392	16,314	211,268	69,124	7,562	54,413	2,113	56,526
Burnley	*Mar. 31, 1915	Dec., 1901	,,	22	18	388,052	326,077	61,975	232,580	10,465	170,852	72,664	29,550	77,161	1,306	78,467
Burton-on-Trent	Mar. 31, 1914	Aug., 1903	,,	10	50	108,632	104,562	4,070	106,275	10,121	49,239	55,323	10,134	15,010	1,497	16,507
Bury	*Mar. 31, 1915	June, 1903	,,	(b)36	10	407,800	284,745	123,055	293,237	12,826	254,832	55,416	33,960	68,740	276	69,016
Chester	Mar. 25, 1914	April, 1903	,,	6	35	92,991	82,380	10,611	82,934	12,883	68,477	14,121	4,282	12,793	480	13,273
Chesterfield	Mar. 31, 1914	Dec., 1904	,,	5	8	98,000	73,500	24,500	69,810	13,663	57,660	13,820	6,307	13,608	465	14,073
Colchester	*Mar. 31, 1915	July, 1904	,,	7	75	70,748	69,555	1,193	69,471	8,736	48,360	22,007	Nil.	13,413	380	13,793
Croydon	*Mar. 31, 1915	(q) Sept., 1901	,,	17	50	287,689	287,689	Nil	286,765	16,271	222,223	107,039	41,643	87,833	781	88,614
Darlington	Mar. 31, 1914	June, 1904	,,	8	71	107,500	77,832	29,668	77,786	8,752	56,178	23,338	6,806	12,976	261	13,237
Darwen	*Mar. 31, 1915	Oct., 1900	,,	7	13	93,400	86,300	7,100	87,199	12,174	51,200	33,555	9,396	14,645	988	15,633
Derby	Mar. 31, 1914	July, 1904	,,	22	20	239,980	239,980	Nil	245,332	11,026	177,676	67,656	(l)32,356	E51,126	1,048	52,174
Doncaster	Mar. 31, 1914	June, 1902	,,	12	58	...	...	...	107,921	8,481	94,700	16,581	1,442	22,890	318	23,208
Dundee	*May 15, 1915	July, 1900	,,	28	32	(f)	362,789	...	371,145	13,068	266,027	96,762	92,694	66,320	1,954	68,274
East Ham	Mar. 31, 1914	June, 1901	,,	14	5	190,643	190,242	401	191,654	13,127	140,457	65,478	3,453	54,079	836	54,915
Exeter	Mar. 31, 1914	April, 1905	,,	7	0	106,000	86,111	19,889	86,111	12,301	67,354	19,249	6,290	17,489	97	17,586
Gloucester	*Mar 31, 1915	April, 1904	,,	15	1	191,000	144,333	46,667	147,783	9,846	104,965	22,901	1,000	16,693	1,114	17,807
Halifax	*Mar. 31, 1915	June, 1898	,,	55	39	449,263	417,466	31,797	420,185	7,570	283,249	129,670	36,442	111,792	1,378	113,170
Ilford	Mar. 31, 1914	Mar., 1903	,,	11	28	149,633	149,633	Nil	149,574	13,178	104,842	44,791	2,297	23,485	2,308	25,793
Ilkeston	Mar. 31, 1914	May, 1903	,,	3	56	64,214	47,000	17,214	47,833	13,436	31,462	16,422	...	6,915	171	7,086
Ipswich	Mar. 31, 1915	Nov., 1903	,,	14	70	116,471	114,300	2,171	115,676	7,776	94,894	115,549	15,940	22,796	493	23,289
Keighley	Mar. 31, 1913	Oct., 1904	,,	6	9	50,934	47,328	3,606	47,328	7,743	32,468	16,961	942	8,845	313	9,158
Kilmarnock	May 15, 1914	Dec., 1904	,,	5	47	65,000	52,795	12,205	53,281	9,536	47,250	8,707	5,298	9,088	265	9,353
Kirkcaldy	*May 15, 1915	Feb., 1903	,,	8	65	213,000	97,868	115,132	97,868	11,105	76,466	21,402	5,223	16,564	412	16,976
Lancaster	Mar. 31, 1914	Jan., 1903	,,	4	65	...	45,700	...	43,684	9,077	30,450	15,350	3,074	5,779	158	5,937
Leith	May 15, 1914	Aug., 1905	,,	17	73	275,000	238,000	37,000	236,877	13,211	179,350	58,650	3,045	36,555	1,170	37,725
Leyton	Mar. 31, 1914	Dec., 1906	,,	18	8	324,201	324,145	56	295,376	16,319	240,741	57,244	2,654	69,148	1,541	70,689
Lincoln	*Mar. 31, 1915	Nov., 1905	S.	2	77	98,519	44,947	53,572	44,987	15,185	40,226	12,529	(l) 692	6,435	117	6,552
Liverpool	Dec. 31, 1914	Nov., 1898	E.	124	0	2,622,786	2,057,850	564,936	2,062,391	16,741	1,168,685	1,177,949	366,545	684,026	13,050	697,076
Lowestoft	Sep. 30, 1914	July, 1903	,,	4	6	96,230	91,178	5,052	91,178	22,375	75,480	17,614	Nil	11,357	373	11,730
Maidstone	Mar. 31, 1914	July, 1904	,,	7	3	82,932	82,932	Nil	79,098	11,239	65,574	17,358	...	10,391	575	10,966
Manchester	*Mar. 31, 1915	June, 1901	,,	203	31	2,361,038	2,207,215	153,823	2,216,009	10,895	1,648,183	548,499	438,497	887,763	14,112	901,875
Nelson	Mar. 31, 1914	Feb., 1903	,,	3	69	38,000	37,885	115	37,885	9,808	29,145	8,740	...	10,801	52	10,853
Newport (Mon.)	*Mar. 31, 1915	April, 1903	,,	14	28	232,500	196,250	36,250	196,184	13,671	155,216	49,868	3,479	41,752	952	42,704
Nottingham	*Mar. 31, 1915	Jan., 1901	,,	44	20	...	...	...	733,674	16,586	473,999	261,364	56,626	176,289	3,026	179,315
Oldham	*Mar. 25, 1915	May, 1902	,,	28 (b) 8	32 31	506,723	446,347	60,376	453,655	15,981	303,738	166,268	2,222	111,679	2,135	113,814
Perth	May 15, 1914	Nov., 1913	,,	6	75	90,000	78,350	11,650	78,629	11,334	...	...	...	8,944	928	9,872
Plymouth	Mar. 31, 1914	Sept., 1899	,,	15	0	182,856	181,479	1,377	219,417	14,628	86,903	89,493	24,252	39,989	891	40,880
Pontypridd	Mar. 31, 1914	Mar., 1905	,,	8	48	...	...	...	133,143	15,482	...	...	...	23,280	320	23,600
Rawtenstall	*Mar. 31, 1915	May, 1909	,,	15	71	193,290	182,172	11,118	182,276	11,709	150,324	31,848	3,051	24,460	1,076	25,536
Rochdale	*Mar. 31, 1915	May, 1902	,,	(i) 40	2	356,991	347,782	9,209	353,200	15,407	347,782	108,034	16,000	77,660	5,742	83,402
Rotherham	*Mar. 31, 1915	Jan., 1903	,,	12	2	342,200	188,326	153,874	184,178	15,316	150,485	33,473	21,771	43,834	59	43,893
			R.T	...		...	...	...	...	...	...	...	...	...	...	...
Salford	*Mar. 31, 1915	Oct., 1901	E.	75	64	1,086,472	723,717	362,755	725,485	9,571	511,853	282,115	30,058	257,935	42	257,977
Southampton	*Mar. 31, 1915	Jan., 1900	,,	18	54	280,452	260,699	19,753	259,834	13,913	158,729	99,470	14,251	68,042	2,996	71,038
Southend-on-Sea	Mar. 31, 1913	July, 1901	,,	11	49	130,000	129,961	39	143,808	12,384	116,940	12,784	3,045	34,453	465	34,918
Southport	Mar. 31, 1914	July, 1900	,,	(d) 10	63	294,000	197,730	94,270	196,178	9,921	150,250	47,480	442	18,391	455	18,846
South Shields	*Mar. 31, 1915	Mar., 1906	,,	10	21	251,882	184,056	67,826	181,097	17,646	155,214	37,314	30,837	39,275	570	33,845
Staly'ge, H., M., D.	*Mar 31, 1915	May, 1904	,,	27	57	325,270	280,990	44,280	279,778	10,096	209,387	71,603	1,211	37,490	130	37,620
Stockport	Mar. 31, 1914	Aug., 1901	,,	27	5	318,847	234,500	84,347	251,514	9,294	158,391	76,109	37,179	66,715	1,322	68,037
Sunderland	*Mar. 31, 1915	Aug., 1900	,,	20	28	308,699	303,211	5,488	306,766	15,074	161,996	132,265	45,044	75,229	386	75,615
Swindon	Mar. 31, 1914	Sept., 1904	,,	4	42	...	...	...	44,216	9,771	33,861	11,738	7,237	8,602	309	8,911
Wallasey	Mar. 31, 1915	Mar., 1902	,,	19	77	208,867	195,290	13,577	222,027	11,122	159,306	72,879	10,612	63,690	815	64,505
Walsall	Dec. 31, 1914	Dec., 1902	,,	19	44	188,145	188,100	45	182,926	9,357	154,044	63,649	34,960	33,311	778	34,089
Walthamstow	Mar. 31, 1915	June, 1905	,,	13	30	198,000	194,000	4,000	190,477	14,251	168,248	25,249	...	41,346	443	41,789
Warrington	Mar. 31, 1914	April, 1902	,,	9	52	103,674	102,896	778	102,128	10,583	70,476	32,422	10,000	23,232	521	23,753
West Ham	*Mar. 31, 1915	Feb., 1904	,,	30	4	578,478	551,588	26,890	556,878	18,532	469,051	123,888	26,236	147,703	4,509	152,212
West Hartlepool	*Mar. 31, 1915	Feb., 1904	,,	8	63	85,494	80,330	5,164	81,731	9,301	76,501	3,682	4,614	19,011	494	19,505
Wigan	*Mar. 31, 1915	April, 1901	,,	30	73	502,513	491,007	11,506	481,577	15,579	382,490	157,287	5,034	75,270	2,107	77,377
Wolverhampton	*Mar. 31, 1915	April, 1902	S.	21	40	279,733	268,185	11,548	292,361	13,596	209,497	71,812	53,987	54,593	730	55,323
Yarmouth (Gt.)	Mar. 31, 1914	June, 1902	E.	14	58	149,600	124,750	24,850	126,363	9,207	116,450	25,996	9,075	25,712	527	26,239
York	Mar. 31, 1914	Jan., 1910	,,	12	20	157,150	157,150	340	156,810	12,853	152,470	6,323	5,092	26,133	642	26,775

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	*Mar. 31, 1915	Nov., 1905	E.	98	54	1,528,146	1,381,200	136,946	1,455,506	14,702	1,343,000	257,730	96,622	266,249	3,988	270,237
Bexley	Mar. 31, 1914	Oct., 1903	,,	6	42	100,798	98,812	1,986	98,408	15,376	75,408	23,403	942	14,698	1,649	16,346
Birkenhead	Mar. 31, 1915	Feb., 1901	,,	24	7	378,973	373,290	5,683	373,545	15,548	228,391	143,241	23,062	65,100	685	65,785
Bournemouth	Mar. 31, 1914	July, 1902	,,	(e) 29	62	471,850	432,440	39,410	443,006	19,821	286,385	146,054	18,409	104,353	616	104,969
Cardiff	*Mar. 31, 1915	May, 1902	,,	31	66	832,356	787,292	45,064	811,043	25,484	485,049	302,242	98,778	139,256	36,785	176,041
Coventry	Mar. 31, 1914	Jan., 1912	,,	15	61	251,014	235,574	15,440	229,197	14,541	230,596	8,517	3,983	42,751	733	43,484
Glasgow	*May 31, 1915	Oct., 1898	,,	198 (b) 2	10 53	4,564,266	3,694,143	870,123	3,751,708	19,127	2,411,868	1,282,275	2,326,543	1,070,694	6,184	1,076,878
Huddersfield	*Mar. 31, 1915	Feb., 1901	,,	56	4	772,662	467,142	305,520	477,919	8,526	281,927	194,599	7,522	124,200	2,859	127,059
Hull	*Mar. 31, 1915	July, 1899	,,	33	12	662,074	594,626	67,448	596,092	17,982	579,628	183,392	147,663	161,750	1,280	163,030
Leeds	*Mar. 31, 1915	Aug., 1897	,,	115	71	1,907,865	1,814,758	93,107	1,678,844	14,487	1,400,687	590,421	4,961	429,902	4,038	433,940
Leicester	Dec. 31, 1914	May, 1904	,,	37	0	1,006,946	818,073	138,290	828,953	22,404	674,936	147,944	91,843	149,664	20,571	170,235
London	*Mar. 31, 1915	...	H.	9	67	...	...	...	...	...	...	...	...	10,261	540	10,801
		May, 1903	C.E	274	35	(c)	(c)	(c)	13,744,806	...	9,836,187	3,786,403	565,095	2,323,130	65,916	2,389,046
N'castle-on-Tyne	*Mar. 31, 1915	Dec., 1901	E.	62	72	1,597,129	1,309,200	287,929	1,332,133	21,178	905,066	524,407	74,656	280,147	13,117	293,264
Northampton	*Mar. 31, 1915	July, 1904	,,	12	37	239,800	147,255	92,545	173,019	13,883	118,932	48,610	14,628	30,775	534	31,309
Portsmouth	*Mar. 31, 1915	Sep., 1901	,,	34	48	708,619	708,619	Nil	731,174	21,132	423,103	285,516	81,715	121,909	2,082	123,991
Preston	Mar. 31, 1914	June, 1904	,,	17	16	224,102	187,269	36,833	187,269	10,888	117,315	47,130	39,392	45,618	328	45,946
Reading	*Mar. 31, 1915	July, 1903	,,	13	14	235,000	234,000	1,000	237,102	17,996	155,419	75,406	19,471	35,608	1,074	36,682
Sheffield	*Mar. 25, 1915	Sep., 1899	,,	79	8	1,782,471	1,484,400	298,071	1,558,246	19,703	1,122,482	512,567	34,450	391,535	2,996	394,531
Wellington, N.Z.	Mar. 31, 1914	...	,,	31	55	496,423	496,423	...	628,151	19,821	496,423	46,836	120,191	157,096	1,161	158,257

C—Electric conduit system. E—Electric trolley system. H—Horse lines RT—Railless trolley system. S—Surface contact system.
(b) Includes leased lines. (c) Conferred by Annual Money Act, which limits amount for each financial year. Powers not exercised are lapsed.
(d) Not including 8 miles 78 chains leased lines. (e) Includes 7 miles 34 chains leased lines. (f) Unlimited. (h) Includes 9 miles 26 chains railless trolley routes.
(i) 17 mi. 8 chn. single track leased. (l) Including Insurance. (p) Including leased lines. (q) Corporation working commenced June, 1906.

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COMPARATIVE ELECTRIC TRAMWAY ACCOUNTS

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Working Expenses.					Gross Profit on Working.	Additions to Gross Profit.	Deductions from Gross Profit.						Net Surplus + or Deficit −
	Traffic.	General.	Repairs & Maintenance.	Power.	Total.			Interest.	Sinking Fund.	Income Tax.	Depreciation & Renewal	Sundries.	Total.	
Aberdeen	23,291	12,148	7,920	8,166	51,525	36,477	...	4,783	5,179	...	13,840	(i) 1,669	25,477	+ 11,000
Accrington	7,570	2,792	2,268	4,880	17,510	12,683	...	3,969	3,783	198	3,100	65	11,115	+ 1,568
Ashton-und'r-Lyne	5,149	1,682	3,053	3,372	13,256	10,763	...	2,590	3,760	477	800	39	7,666	+ 3,097
Ayr	4,682	(i)2,301	1,494	2,504	10,981	7,004	...	2,487	2,310	...	2,207	...	7,004	...
Birmingham	183,119	59,947	88,698	113,743	445,507	189,964	8,487	68,478	53,804	...	...	197	122,479	+ 75,972
Blackburn	16,859	6,197	14,451	9,421	46,928	21,374	287	(h) 4,388	15,450	251	1,572	...	21,661	...
Blackpool	17,632	(i 7,755	9,239	10,225	44,851	31,254	...	(h) 9,878	7,640	...	...	...	17,518	+ 13,736
Bolton	30,044	(q) 9,486	15,912	20,689	76,131	65,279	857	(h) 10,525	17,520	1,713	18,339	(i) 981	49,078	+ 17,058
Bradford	91,597	(i)36,890	64,670	52,938	246,095	83,793	4,525	22,087	24,164	5,422	7,832	4,203	63,708	+ 24,610
Brighton	14,152	(i) 6,759	13,690	8,384	42,985	13,541	55	7,661	5,917	...	...	...	13,578	+ 18
Burnley	21,142	(i)10,079	9,141	17,955	58,317	20,150	...	6,796	8,284	1,515	...	(f) 1,890	18,486	+ 1,664
Burton-on-Trent	5,442	1,502	2,562	3,154	12,660	3,847	(q) 1,524	1,364	1,344	...	1,500	...	4,208	+ 1,163
Bury	16,129	4,971	7,162	7,504	35,766	33,250	303	(h) 7,037	6,026	825	2,472	(w) 11,193	27,553	+ 6,000
Chester	3,290	1,534	1,208	2,096	8,128	5,145	158	(h) 2,754	1,018	...	...	...	3,772	+ 1,531
Chesterfield	3,214	1,368	2,936	2,192	9,710	4,363	269	2,275	1,900	...	...	...	4,175	+ 497
Colchester	3,045	1,372	2,370	2,783	9,570	4,223	28	(h) 1,986	2,496	...	...	(i) 172	4,654	− 403
Croydon	31,319	(i) 9,151	14,128	17,684	72,282	16,332	749	7,883	7,415	1,587	...	...	16,891	+ 190
Darlington	4,305	812	1,995	2,012	9,124	4,113	101	(h) 1,944	1,996	102	469	...	4,511	− 297
Darwen	4,064	1,146	3,260	2,653	11,123	4,510	222	2,221	2,190	...	1,050	...	5,461	− 729
Derby	E 17,320 H 540	2,906 ...	5,499 81	8,610 ...	34,335 621	17,839 def. 173	239	6,236	3,464	...	5,536	(l) 185	15,421	+ 2,687
Doncaster	4,969	1,342	6,550	4,166	17,027	6,181	16	2,935	1,840	138	572	58	5,543	+ 684
Dundee	17,829	(i)7,398	7,445	10,686	43,358	24,916	...	8,990	6,700	323	7,842	...	23,855	+ 1,061
East Ham	18,739	6,802	12,067	10,521	48,129	6,786	...	(h) 5,570	6,882	...	...	573	13,025	− 6,239
Exeter	4,888	1,373	1,483	3,827	11,571	6,015	...	(h 2,305	1,885	101	...	...	4,291	+ 1,724
Gloucester	7,250	1,643	2,975	1,836	13,704	4,103	...	(h) 5,362	1,881	370	...	...	7,613	− 3,510
Halifax	30,501	7,877	13,529	21,597	73,504	39,321	345	10,424	12,106	...	(y) 925	(i) 2,632	23,455	+ 16,211
Ilford	9,916	2,431	3,740	4,791	20,878	4,915	557	3,969	5,070	...	...	...	9,039	− 3,567
Ilkeston	2,262	789	1,378	1,460	5,889	1,197	160	1,450	1,532	90	...	96	3,168	− 1,811
Ipswich	8,801	1,962	5,033	3,494	19,290	3,999	(u) 4,877	(h) 3,660	2,207	...	3,421	(i) 237	9,525	− 649
Keighley	2,692	768	899	1,612	5,971	3,187	179	1,116	1,881	...	...	(n 369	3,366	...
Kilmarnock	3,195	746	1,327	1,717	6,985	2,368	...	1,628	1,252	...	1,160	...	4,040	− 1,672
Kirkcaldy	4,811	1,416	2,312	2,912	11,451	5,525	68	2,604	2,411	...	409	136	5,560	+ 33
Lancaster	2,290	522	841	1,594	5,247	690	52	1,158	1,511	...	...	...	2,669	− 1,927
Leith	9,742	3,131	5,080	3,920	21,873	15,852	242	(h) 6,211	7,850	...	2,274	67	16,402	− 308
Leyton	(p) 22,360	8,611	13,711	12,923	57,605	13,084	133	10,007	8,461	...	...	202	18,670	− 5,453
Lincoln	1,446	656	967	872	3,941	2,611	47	1,529	1,071	...	...	(i) 6	2,606	+ 82
Liverpool	192,352	69,830	83,100	123,527	468,809	228,267	25,251	50,082	63,726	...	(d) 34,821	(e) 4,869	153,498	+ 100,000
Lowestoft	3,405	655	1,552	2,323	7,935	3,795	..	2,441	2,251	...	...	...	4,692	− 897
Maidstone	2,609	1,062	1,686	1,934	7,291	3,675	57	2,470	1,969	...	...	114	4,553	− 821
Manchester	273,002	(i)117,573	85,280	128,350	604,205	297,670	14,615	(h) 58,243	57,599	13,790	48,584	(c) 34,069	212,285	+ 100,000
Nelson	2,537	684	1,525	2,123	6,869	3,984	...	978	1,026	...	...	...	2,004	+ 1,980
Newport (Mon.)	10,429	4,234	9,655	6,638	30,956	11,748	857	5,694	4,357	...	1,886	(i) 668	12,605	...
Nottingham	48,272	14,674	17,408	30,692	111,046	68,269	...	16,444	21,121	...	...	(i) 2,040	39,605	+ 28,664
Oldham	27,159	10,158	28,025	19,742	85,084	28,730	1,639	16,158	11,734	2,347	...	(g) 5,799	36,038	− 5,669
Perth	...	...	...	...	6,002	3,870	...	...	...	...	...	...	...	...
Plymouth	8,430	3,896	4,514	8,026	24,866	16,014	1,257	4,282	3,141	690	5,121	...	13,234	+ 4,037
Pontypridd	...	...	...	...	16,111	...	...	...	...	...	...	...	...	...
Rawtenstall	6,126	2,446	3,187	4,273	16,032	9,504	85	5,483	6,493	...	...	...	11,976	− 2,387
Rochdale	19,308	5,063	10,984	11,537	46,892	36,510	1,636	11,478	9,594	2,038	...	(i) (z) 10,752	33,862	+ 4,284
Rotherham	E 11,039 RT ...	4,071 ...	5,864 ...	8,718 ...	29,692 ...	14,201 ...	195 ...	5,349 ...	3,465 ...	... ...	4,082 ...	... ...	12,896 ...	+ 1,800 ...
Salford	75,579	(i)24,562	27,778	48,819	176,748	81,229	4,477	15,791	668	4,112	492	(k) 29,378	51,441	+ 34,265
Southampton	21,466	(i) 6,862	9,433	12,545	50,306	20,732	(t) 6,757	7,564	7,557	952	5,000	...	21,073	+ 6,416
Southend-on-Sea	8,046	2,260	3,534	6,187	20,027	14,891	4,228	(h) 3,834	1,753	...	4,017	...	9,605	+ 9,514
Southport	4,754	2,126	3,103	2,999	12,982	5,864	6,379	6,516	5,018	...	2,144	...	13,678	− 1,435
South Shields	9,249	(i) 5,225	4,156	6,880	25,510	14,335	140	5,230	3,651	...	...	...	8,881	+ 5,894
Staly'dge, H., M., D.	12,818	(i) 5,022	7,448	5,761	32,049	5,571	...	7,485	7,786	...	400	397	16,068	− 10,497
Stockport	14,828	4,583	10,045	5,964	35,420	32,617	1,170	5,432	8,909	1,163	2,369	(j) 3,414	21,287	+ 12,500
Sunderland	19,807	5,608	4,867	11,267	41,549	34,066	265	(h) 6,464	10,374	1,218	10,875	400	29,331	+ 5,000
Swindon	2,854	828	1,534	1,850	7,066	1,845	45	1,215	1,422	...	...	...	2,637	− 747
Wallasey	18,736	(i) 6,704	6,213	10,801	42,454	22,051	1,249	5,520	5,072	...	...	634	11,226	+ 12,074
Walsall	8,510	3,326	4,315	5,670	21,821	12,268	1,339	4,962	3,975	551	640	...	10,128	+ 3,479
Walthamstow	14,417	2,972	8,845	8,546	34,780	7,009	30	(h) 6,427	3,468	...	...	(i) 712	10,607	− 3,568
Warrington	5,999	1,834	3,973	3,411	15,217	8,536	537	2,481	3,353	...	...	...	5,834	+ 3,239
West Ham	52,659	†14,531	33,326	19,420	119,936	32,276	243	18,875	12,679	...	692	...	32,246	+ 273
West Hartlepool	4,791	1,586	2,956	2,241	11,574	7,951	3	2,569	1,847	...	..	(f) 500	4,916	+ 3,018
Wigan	17,340	5,252	12,768	10,817	46,177	31,200	331	(h) 13,866	13,101	...	...	3,662	30,629	+ 902
Wolverhampton	13,031	(i) 6,239	8,594	7,202	35,066	20,257	(x) 2,535	7,760	5,669	203	5,416	...	19,048	+ 3,744
Yarmouth (Gt.)	7,756	1,849	3,052	4,951	17,608	8,631	75	(h) 4,065	2,826	...	1,815	...	8,706	...
York	8,713	2,028	1,936	5,259	17,936	8,839	...	(h) 4,609	1,706	...	...	...	6,315	+ 2,524

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

Belfast	75,752	17,245	35,294	28,622	156,913	113,325	...	48,342	31,277	1,478	17,879	2,164	101,140	+ 12,185
Bexley	3,282	1,382	*3,554	828	(s) 11,630	4,716	...	2,794	2,509	...	324	...	5,627	− 911
Birkenhead	15,923	(i) 5,621	12,124	5,839	39,507	26,278	...	(h) 11,340	9,760	527	3,500	151	25,278	+ 1,000
Bournemouth	24,154	8,350	10,307	16,200	59,011	45,958	2,550	(h) 10,265	15,255	...	12,871	(e) 8,117	46,508	+ 2,000
Cardiff	43,914	11,332	26,879	26,593	108,718	67,323	1,123	23,925	22,645	2,272	6,947	2,655	58,444	+ 10,002
Coventry	12,861	4,471	7,945	3,839	29,116	14,368	478	8,506	5,230	...	277	414	14,427	+ 419
Glasgow	345,625	(i)193,837	144,530	51,995	735,987	340,891	65,826	78,797	105,492	22,790	172,310	14,377	393,766	+ 12,951
Huddersfield	33,571	(i) 7,911	20,449	12,047	73,978	53,081	...	(h) 12,536	13,061	2,274	15,575	1,235	44,681	+ 8,400
Hull	(i) 58,137	12,634	31,909	11,622	114,302	48,728	...	16,578	13,883	576	3,117	...	34,154	+ 14,574
Leeds	115,601	40,347	43,609	28,577	228,134	205,805	7,837	47,174	57,773	7,356	11,928	(i) 7,844	132,075	+ 81,567
Leicester	59,052	11,397	22,836	25,322	118,607	51,628	1,660	24,218	13,764	2,801	10,741	1,284	52,808	+ 480
London	H. 4,737 E. 793,481	1,859 (r) 276,574	3,878 364,064	(m) 5,854 250,124	16,328 1,684,243	def. 5,527 704,803	... 47,425	330,301	405,605	32,102	1,541	(l) 15,851	785,400	− 33,172
N'castle on-Tyne	79,328	25,580	31,120	24,430	160,458	132,806	3,197	(h) 29,574	43,356	5,411	68	(i) 13,837	92,246	+ 43,757
Northampton	8,428	3,187	3,103	6,136	20,854	10,455	473	(h) 3,900	4,624	441	90	(sb) 1,221	10,276	+ 652
Portsmouth	31,414	(i) 13,293	8,371	5,580	58,658	65,333	(a) 11,483	21,643	18,455	1,941	11,677	532	54,248	+ 22,568
Preston	12,350	4,989	9,252	2,995	29,586	16,360	...	3,625	5,038	...	...	1,356	10,019	+ 6,341
Reading	8,324	(i) 4,356	4,313	3,643	20,664	16,028	11	6,709	5,062	263	...	...	12,034	+ 4,005
Sheffield	120,296	(i) 31,784	45,385	49,365	246,830	147,701	2,056	31,747	42,504	5,567	30,017	8,014	117,849	+ 31,908
Wellington, N.Z.	57,973	7,775	21,918	17,947	105,613	52,644	2,091	19,865	4,757	...	14,682	...	39,304	+ 15,431

(a) Includes £10,708 balance forward from previous year. (b) Includes £152 loss on omnibus account less profit on parcel service. (c) Includes £1,611 insurance fund. (d) Includes reserve. (e) Includes rents for leased lines. (f) Rent of leased lines. (g) Rent of lines and deficit on motor omnibus account. (h) Including income tax. (i) Includes Army Service Allowance. (j) Includes £693 deficit on railless traction. (k) Includes rents of lines. (l) Including loss on horse traction. (m) Horsing expenses. (n) Transferred to motor omnibus capital account. (o) Includes £1,837 through-running contributions. (p) Includes £407 horse account. (q) Includes National Insurance. (r) Including special charges. (s) Includes £2,584 through-running contributions to L.C.C. (t) Includes balance forward from previous year. (u) From borough fund. (w) Amount apportioned to leased lines. (x) Includes £1,554 profit on motor char-a-banc. (y) Parliamentary Expenses. (z) Includes £6,519 rent of leased lines. * Includes £1,913 spent on renewals. † Under a resolution of the Council, the allowances to employees serving with the Forces, amounting to £6,031, are defrayed out of rates and therefore not included in these accounts. ‡ £2,950 profit from 3 months' working.

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COMPARATIVE ELECTRIC TRAMWAY ACCOUNTS

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Appropriation of Net Surplus.			Receipts per Car Mile.		Operating Expenses per Car Mile.					Percentage of Operating Expenses to Total Revenue.	Average Operating Expenses per Car Mile (excludi'g Power Cost).	Board of Trade Units.		
	Carried Forward.	Reserve.	Contribution to Rates or Municip'l Funds.	Average Total per Car Mile.	Average Traffic per Car Mile.	Traffic.	General.	Repairs and Maintenance.	Power. (Price paid)	Total.			Units.	Cost per Unit.	Units used per car mile.
				d.	d.	d.	d.	d.	d.	d.	%	d.		d.	
Aberdeen ...	...	7,590	3,410	11·06	10·89	2·93	1·53	·99	1·03	6·48	58·54	5·45	2,317,204	·845	1·027
Accrington ...	...	...	1,568	12·64	12·49	3·17	1·18	·94	2·04	7·33	57·99	5·29	949,054	1·23	1·65
Ashton-u-Lyne	47	...	3,050	12·4197	12·0692	2·6622	·8695	1·5788	1·7434	6·8539	55·19	5·1105	640,413	1·25	1·38
Ayr...	...	...	...	9·61	9·18	2·50	1·25	·79	1·33	5·87	63	4·47	442,969	1·28	·98
Birmingham ...	...	31,000	44,972	10·689	10·564	3·080	1·009	1·492	1·913	7·494	70	5·581	24,257,823	1·125	1·70
Blackburn ...	...	...	...	13·81	13·71	3·40	1·25	2·92	1·91	9·48	68·70	7·57	1,739,274	1·3	1·54
Blackpool ...	...	1,736	12,000	16·82	16·65	3·90	1·71	2·04	2·26	9·91	58·93	7·65	1,552,635	1·58	1·43
Bolton	58	...	17,000	11·758	11·656	2·498	·788	1·323	1·721	6·330	53·836	4·610	4,514,010	1·1	1·56
Bradford	...	14,610	10,000	12·425	11·816	3·457	1·041	2·450	2·027	8·975	74·60	6·948	12,272,121	1	1·926
Brighton	18	...	...	12·240	11·782	3·064	1·464	2·964	1·816	9·308	72·79	7·10	1,676,770	1·2	1·51
Burnley	...	...	1,664	11·450	11·259	3·085	1·108	1·334	2·620	8·147	71·16	5·53	3,621,567	1·15	2·20
Burton-on-Trent	1,163	...	...	9·02	8·28	2·97	·82	1·40	1·72	6·91	76·7	5·08	545,672	1·39	1·08
Bury	...	(k)1,000	5,000	10·26	10·22	2·399	·776	1·253	1·268	5·696	51·82	4·428	2,045,692	1·25	1·26
Chester	...	1,531	...	9·17	8·84	2·27	1·06	·83	1·45	5·61	61	4·17	378,158	1·33	1·08
Chesterfield ...	...	457	...	11·1	10·8	2·54	1·08	2·31	1·73	7·66	68·9	5·93	420,824	1·25	1·38
Colchester ...	...	...	...	9·942	9·668	2·194	·989	1·709	2·006	6·898	69·24	4·892	445,214	1·5	1·34
Croydon	...	190	...	7·593	7·526	2·683	·784	1·211	1·516	6·194	78·68	4·493	3,000,308	1·416	1·071
Darlington ...	...	...	...	8·230	8·068	2·676	·505	1·241	1·251	5·673	68·93	4·422	482,791	1	1·25
Darwen	...	...	...	14·02	13·13	3·65	1·03	2·93	2·38	9·99	71·15	7·61	485,033	1·312	1·812
Derby	(n) 75	...	...	E 10·358 H. 6·077	10·150 5·821	3·438 7·325	·577 ...	1·092 1·099	1·709 ...	6·816 8·424	65·8 138·6	5·107 ...	1,425,112 ...	1·45 ...	1·179 ...
Doncaster ...	...	654	...	10·52	10·37	2·24	·61	2·97	1·90	7·72	73·1	5·82	799,965	1·25	1·51
Dundee	...	61	1,000	11·802	11·465	3·082	1·278	1·288	1·847	7·495	63·5	5·648	2,564,659	1	1·847
East Ham ...	...	...	...	8·73	8·59	2·98	1·08	1·92	1·67	7·65	87·60	5·98	2,385,535	1·062	1·58
Exeter	...	1,724	...	9·456	9·404	2·628	·738	·797	2·059	6·222	65·8	4·163	565,247	1·625	1·27
Gloucester ...	...	...	...	6·84	6·41	2·78	·63	1·14	·71	5·26	77	4·55	470,336	1	·70
Halifax	...	(r) 7,483	(s)6,171	11·657	11·514	3·141	·812	1·393	2·225	7·571	65	5·35	4,607,293	1·125	1·98
Ilford	...	...	...	6·891	6·768	2·862	·688	1·048	1·278	5·877	80·9	4·598	1,079,384	1·065	1·175
Ilkeston	...	...	...	7·04	6·87	2·3	·8	1·3	1·4	5·8	83	4·4	372,200	1	1·54
Ipswich	...	...	...	8·705	8·52	3·290	·732	1·882	1·306	7·210	82·83	5·904	670,809	1·25	1·045
Keighley	...	...	...	9·064	8·754	2·664	·761	·890	1·595	5·910	65	4·315	254,636	1·5	1·05
Kilmarnock ...	...	...	...	7·539	7·326	2·57	·61	1·07	1·38	5·63	74·6	4·246	329,577	1·25	1·14
Kirkcaldy ...	33	...	...	9·085	8·864	2·574	·758	1·238	1·558	6·128	67·4	4·57	698,804	1	1·558
Lancaster ...	...	...	...	8·23	7·94	3·14	·71	1·16	2·19	7·20	88	5·02	225,094	1·7	1·29
Leith	...	...	...	9·54	9·24	2·46	·79	1·29	·99	5·53	57·98	4·54	939,737	1·001	·99
Leyton	...	...	...	9·355	9·151	(c) 2·959	1·140	1·815	1·710	7·624	81·338	5·914	3,043,900	1·019	1·678
Lincoln	52	...	...	10·59	10·40	2·34	1·06	1·56	1·41	6·37	60·2	4·96	173,895	1·25	1·128
Liverpool ...	...	...	100,000	12·25	12·02	3·380	1·227	1·460	2·171	8·238	65·6	6·067	26,007,694	1·14	1·9
Lowestoft ...	...	...	...	9·1	8·8	2·60	·5	1·2	1·8	6·1	67·64	4·3	318,601	1·75	1·03
Maidstone ...	...	...	...	8·51	8·06	2·02	·81	1·34	1·48	5·65	70·07	4·17	371,290	1·25	1·2
Manchester ...	...	...	100,000	11·300	11·123	3·420	1·473	1·069	1·608	7·570	63·47	5·962	29,922,197	1·029	1·562
Nelson	1,980	...	...	12·85	12·78	3·00	·81	1·81	2·51	8·13	63	5·62	255,621	2	1·26
Newport (Mon.)...	...	...	...	10·622	10·385	2·594	1·053	2·402	1·651	7·700	72·49	6·049	1,178,500	1·30	1·22
Nottingham ...	...	6,164	22,500	11·35	11·16	3·06	·93	1·10	1·94	7·03	62·78	5·09	5,806,688	1·25	1·53
Oldham	...	...	...	13·351	13·101	3·186	1·191	3·288	2·316	9·981	74·75	7·665	3,158,752	1·5	1·544
Perth	...	...	...	9·39	8·51	3·08	·40	·77	1·46	5·71	60·79	4·25	295,846	1·25	1·17
Plymouth ...	...	...	4,037	12·066	11·450	2·42	1·11	1·29	2·298	7·12	60·83	4·82	1,159,069	1·66	1·38
Pontypridd ...	...	...	...	13·29	13·11	2·82	3·67	·74	1·84	9·07	68·26	7·23	627,593	1·25	1·47
Rawtenstall ...	...	...	...	10·11	9·699	2·40	·99	1·27	1·69	6·35	62·57	4·66	833,714	1·23	1·37
Rochdale	4,284	...	...	11·292	11·134	2·611	·682	1·524	1·654	6·471	56·2	4·817	2,836,062	1·006	1·694
Rotherham ...	E. ... R.T....	...	1,500	12·37 ...	12·37 ...	3·11 ...	1·15 ...	1·65 ..	2·46 ...	8·37 ...	67·65 ...	5·91 ...	1,669,691 ...	1·25 ...	1·96 ...
Salford	...	12,265	22,000	10·623	10·622	3·112	1·011	1·144	2·050	7·317	66	4·972	9,602,534	1·22	1·667
Southampton ...	1,282	...	5,134	...	...	...	...	...	...	...	...	...	...	...	...
Southend-on-Sea	2,514	1,000	6,000	13·14	12·97	3·03	·85	1·33	2·33	7·54	57·35	5·21	848,538	1·75	1·33
Southport ...	...	...	...	9·763	9·528	2·462	1·101	1·607	1·554	6·725	68·8	5·171	468,554	1·5	1·011
South Shields ...	...	3,194	2,400	10·308	10·160	2·392	1·352	1·075	1·780	6·599	62·4	4·652	1,200,086	1·353	1·293
Stalybridge, &c.	...	...	...	8·084	8·056	2·755	1·079	1·600	1·453	6·887	83·15	5·269	1,803,063	·9	1·614
Stockport ...	.	250	12,250	10·958	10·745	2·388	·738	1·618	·961	5·705	47·94	4·744	...	...	...
Sunderland ...	...	...	5,000	12·210	12·148	3·198	·905	·786	1·820	6·709	54·75	4·8	1,802,694	1·5	1·21
Swindon	...	...	...	9·62	9·24	3·06	·89	1·65	1·99	7·59	79·29	5·60	277,568	1·6	1·24
Wallasey ...	...	4,500	(a) 8,000	12·048	11·896	3·499	1·252	1·160	2·018	7·929	65·8	5·911	1,851,649	1·4	1·44
Walsall	2,479	...	1,000	11·353	11·094	2·834	1·108	1·437	1·888	7·267	64·012	5·379	838 649	1·68	1·164
Walthamstow ...	...	...	...	8·75	8·66	3·02	·62	1·85	1·79	7·28	83·23	5·49	1,491,700	1·375	1·3
Warrington ...	739	...	2,500	12·521	12·246	3·161	·966	2·096	1·798	8·021	68·273	6·223	545,817	1·5	1·199
West Ham ...	...	273	...	9·713	9·427	3·359	1·314	2·127	1·239	8·039	78	6·41	6,306,731	·75	1·66
West Hartlepool	...	3,018	...	9·77	9·52	2·39	·79	1·49	1·13	5·80	59	4·67	680,972	·78	1·42
Wigan	902	...	...	12·415	12·077	2·791	·866	2·052	1·736	7·445	59·70	5·80	2,186,073	1·187	1·461
Wolverhampton	...	...	3,744	11·239	11·091	2·648	1·267	1·746	1·463	7·124	62·5	5·661	1,712,796	1	1·45
Yarmouth (Gt.)...	...	...	...	8·738	8·563	2·583	·616	1·016	1·649	5·864	68·48	4·215	758,296	1·56	1·052
York	...	2,524	...	9·08	8·86	2·95	·69	·66	1·78	6·08	67	4·30	1,009,827	1·25	1·43

TABLE II.—TOWNS WITH SEPARATE GENERATING STATIONS FOR TRACTION.

									*					Works Cost.	
Belfast	...	...	12,185	10·08	9·93	2·83	·64	1·32	1·07	5·86	58·07	4·79	10,439,757	·658	1·39
Bexley	...	..	...	11·13	12·3	2·53	·85	2·82	·68	6·88	71·1	6·20	487,110	·827	1·66
Birkenhead ...	...	1,000	...	13·058	12·922	3·161	1·115	2·406	1·160	7·842	59·99	6·67	2,341,009	·60	1·936
Bournemouth ...	...	2,000	...	12·83	12·76	2·95	1·02	1·26	(b) 1·99	7·22	56·21	5·23	3,245,277	·67	1·65
Cardiff	10,002	...	...	12·354	12·14	3·843	·992	1·358	·835	7·028	59·1	6·193	4,936,582	·475	1·80
Coventry ...	419	...	...	9·271	9·115	2·742	·953	1·694	·819	6·208	66·9	5·389	1,652,029	·544	1·47
Glasgow	...	...	12,951	10·674	10·612	3·426	1·922	1·432	·515	7·295	59·87	6·266	33,848,947	·366	1·40
Huddersfield ...	8,400	...	...	11·05	10·79	2·92	·70	1·78	1·04	6·44	58·22	5·40	5,398,258	·49	1·93
Hull	...	4,574	10,000	8·61	8·53	2·87	·66	1·68	·61	5·82	67·58	5·26	6,352,263	·44	1·40
Leeds	...	...	81,567	10·936	10·834	2·914	1·016	1·099	·720	5·749	52·57	5·029	18,862,847	·668	1·918
Leicester ...	...	...	480	9·875	8·682	3·425	·661	1·325	1·469	6·880	69	5·411	7,540,856	·420	1·82
London	...	...	...	E. 9·77 H. 9·51	9·50 9·03	3·24 4·17	1·14 1·64	1·49 3·41	1·02 5·15	6·89 14·37	68·78 151·17	5·69 14·37	152,666,477 ...	·615 ...	2·60 ...
N'castle-on-Tyne	...	25,757	18,000	12·187	11·642	3·297	1·063	1·293	1·015	6·668	53·02	5·653	11,259,266	·382	1·968
Northampton ...	...	652	...	10·89	10·70	2·94	1·10	1·08	2·13	7·25	68	5·12	1,189,423	1·24	1·57
Portsmouth ...	6,568	(t) 6,000	10,000	12·201	11·997	3·092	1·308	·824	·549	5·773	45·88	5·050	3,272,089	·483	1·139
Preston	...	5,041	1,300	10·75	10·54	2·890	1·168	2·164	·700	6·922	64·40	6·222	1,765,250	·407	1·49
Reading	...	1,005	3,000	9·520	9·242	2·165	1·131	1·119	·945	5·360	54·55	4·248	1,180,507	·740	1·15
Sheffield	...	9,032	22,876	10·747	10·666	3·277	·866	1·236	1·345	6·724	61·116	5·379	18,329,775	646	1·979
Wellington, N.Z.	15,431	...	..	16·309	16·189	5·974	·801	2·259	1·850	10·884	65·86	9·034	4,769,149	·906	2·05

* The figures given under "Power" in Table II. include actual works costs only. H—Horse lines. E—Electric trolley system. (a)—Debit balance forward £426.
(b) Including current supplied by Bournemouth and Poole Supply Company. (c) Horse account ·054d. (f) Insurance fund. (i) Including Insurance. (k) Insurance.
(n) Remainder expended in paying capital expenditure not borrowed. (r) Renewals Fund. (s) Military Allowances, &c., £2,557. (t) Amounts for 15 months.

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COMPARATIVE ELECTRIC TRAMWAY ACCOUNTS

Specially Compiled for "The Tramway and Railway World."

TABLE I.—TOWNS WITH COMBINED GENERATING STATION FOR TRACTION AND LIGHTING PURPOSES.

Name.	Population Served.	Car Mileage.	Passengers Carried.	Traffic Records. Passengers Carried per Car Mile.	Average Fare per Passenger. d.	Average Journeys per Head of Popular'n per Annum.	Average Car Miles per Day per Car.	Traffic Revenue per Mile of Single Track. £	Average Traffic Revenue per Annum per Head of Popular'n Served.	Operating Expenses per Passenger. d.	Average Distance of 1d. Fare Miles.	Average Fare Charged per Mile. d.	Average Speed per Hour. Miles.	Average Total Car Hours per Day.	Average Number of Cars in Use Daily.	Number of Cars in Stock.
Aberdeen ..	165,000	1,909,009	24,048,816	12·59	·86	145·8	90	3,121	10/6	·514	1·861	·87	7·5	812	63	83
Accrington...	45,525	373,336	4,998,979	8·72	1·377	109·8	105	3,033	13/1	·84	1·07	·929	7·5	250	18	27
Ashton-u-L.	50,000	464,160	5,053,701	10·888	·648	173·09	106	2,851	9/4	·368	1·223	·81	8	190	12	25
Ayr	33,000	448,725	4,019,771	8·96	1·02	122	103	1,832	10,5	·65	1·25	·75	8	168	12	22
Birmingham	868,430	14,268,24	146,930,986	10·29	1·03	169	79·77	5,482	14·5	·904	2·	·427	7·87	10·16	500	550
Blackburn ...	200,000	1,121,769	12,223,569	10·89	1·28	61·12	105	2,528	6/6	·902	1·26	·76	7·50	434	31	61
Blackpool ...	67,500	1,085,653	13,624,514	12·55	1·32	201·8	103	4,370	22/4	·79	...	...	8	...	29	84
Bolton ...	221,000	2,886,180	31,370,166	10·86	1·066	141·49	124·07	2,920	12/8	·582	1·553	·633	7·25	980	70	112
Bradford ...	370,000	6,194,057	70,077,271	11·31	1·059	189	113	2,807	16/6	·84	1·66	·530	7·3	2,402·5	155	252
Brighton ...	133,936	1,108,352	11,837,828	11	1·10	88·38	76·08	3,165	8/1½	·83	1·27	·787	6·41	512	32	53
Burnley ..	175,000	1,644,712	15,867,699	9·65	1·16	96	120	3,544	8/10	·88	1·25	·83	7	798	42	67
Burton ...	48,000	439,248	3,339,184	7·60	1·058	70	...	1,782	6/3	·91	1·505	·58	7·5	...	...	20
Bury	128,202	1,613,357	15,513,264	9	1·07	121·47	99·73	1,904	10/9	·554	1·30	·77	8·54	...	...	54
Chester ...	39,028	347,260	3,217,899	9·26	·95	82·45	95	1,987	6/7	·606	1·27	·8	7	150·6	10·04	18
Chesterfield	50,000	304,376	2,950,774	9·7	1·1	76	122	2,668	5/5	·78	1·38	·75	7·33	126	7	17
Colchester ...	65,000	332,963	2,434,786	7·31	1·32	37·46	86·80	1,689	4/1	·94	·85	·96	6·77	147·14	10·51	18
Croydon ...	181,956	2,803,883	19,847,402	7·08	1·062	109·08	128	4,983	9/9	·850	2·15	·50	8·23	933·60	60	75
Darlington...	60,000	385,999	4,140,269	10·7	·752	69	96·1	1,460	4/4	·53	1·219	·45	6·66	151·25	11	18
Darwen ...	...	257,670	2,741,987	10·24	1·28	...	...	2,045	...	·97	...	...	...	...	...	...
Derby ...	124,000	E 1,208,880 H. 17,710	12,136,148 110,231	10·039 6·224	1·011 ·935	} 97·88	...	{ 2,398 ...	8/3 ...	·67 1·35	1·44 1	·75 1	6·375 ..	...	...	50 3
Doncaster ...	60,000	529,122	5,747,273	10·86	·955	95·79	93·9	1,798	7/7	·711	1·25	·76	7·5	239	18	32
Dundee ..	165,000	1,388,345	18,753,140	13·50	·851	113	...	2,345	8/-	·544	2	·50	7·3	...	...	72
East Ham ...	145,000	1,510,251	16,671,505	11·04	·78	115	150	3,704	7/1	·69	1·635	·634	7	216	32	45
Exeter ...	48,660	446,338	4,320,459	9·68	·97	88·8	82·125	2,498	7/2	·642	1·1	·902	5·76	228	16	20
Gloucester ...	53,972	624,402	4,358,510	7	·92	81	90·60	1,113	6/2	·75	1·5	·68	7·08	250·8	19	30
Halifax ...	176,000	2,330,104	20,707,071	8·89	1·27	118	81·76	2,015	12/8	·852	1·553	·82	7·23	883·74	78	101
Ilford ...	84,000	899,515	8,036,552	9·70	·758	95·7	...	2,236	5/7	·62	1·543	·69	8	...	..	26
Ilkeston ...	32,000	241,548	1,746,382	7·2	·95	...	90	1,942	52/8	·8	1·50	·5	7	101	7	13
Ipswich ...	76,472	642,092	5,610,332	8·73	·975	73·4	64·4	1,532	6/-	·82	1·53	·693	5·47	322·56	20·16	36
Keighley ...	43,000	242,500	3,099,272	12·8	·68	72·08	55·35	1,447	4/1	·462	2·22	·45	6·87	126	7	12
Kilmarnock	36,000	297,743	2,482,034	8·33	·875	68·94	93·12	1,632	5/-	·675	1·13	·86	7·22	109·14	8·76	14
Kirkcaldy ..	39,600	448,469	5,492,120	12·24	·723	138	49	1,882	8/4	·5	1·522	·64	7	158	17	22
Lancaster ..	41,786	174,752	1,603,321	9·17	·865	38·37	76	1,204	2/9	·785	1·71	·5	8	87·22	6·23	12
Leith ..	110,400	949,322	10,244,235	10·79	·86	92·8	125	2,031	6/8	·512	1·32	·72	8·3	314	21	37
Leyton ..	124,735	1,813,462	17,472,882	9·64	·950	140	120	3,820	11/1	·791	1·77	·95	8·25	14·5	40·0375	60
Lincoln ..	20,000	148,440	1,713,542	11·5	·89	85·67	59·3	2,169	6/5	·552	1·75	·428	7	72	4	8
Liverpool ...	840,000	13,687,888	145,656,374	10·67	1·127	173·40	89·09	5,516	16/3	·772	2·514	·39	7·75	5,040	420	596
Lowestoft ...	35,000	307,838	2,706,348	8	1·07	77·32	70·25	2,787	6/6	·703	1·5	·7	5·75	192	12	19
Maidstone ..	25,000	309,256	2,407,769	7·783	1·036	96·312	85	1,476	8/4	·725	1	1	6·8	133	12	19
Manchester	957,500	19,155,051	202,768,420	10·6	1·06	212	93·5	4,835	18/7	·717	2·514	...	7·75	7·2	561	683
Nelson ...	45,000	202,781	2,949,784	14·55	·88	65·55	92·59	2,796	4/9	·56	1	1	5·50	108	6	11
Newport ...	90,000	964,895	9,410,109	9·75	1·09	104	...	2,909	9/3	·79	1·164	·898	...	...	...	44
Nottingham	264,000	3,789,887	41,210,964	10·87	1·02	156	95·28	3,984	13/4	·646	1·75	·442	6·92	...	109	155
Oldham ...	180,000	2,045,840	22,171,712	10·837	1·19	123·176	...	3,018	12/4	·92	1·13	·863	7	...	...	97
Perth... ...	35,900	252,216	1,844,588	7·31	1·16	51	...	1,289	5/-	·78	...	...	...	...	...	...
Plymouth ...	112,000	838,142	9,333,087	11·13	1·027	83·33	...	2,666	7/2	·639	...	...	...	...	...	42
Pontypridd...	50,000	426,228	5,577,666	13·09	1	111	...	2,707	9/4	·69	...	...	...	...	...	...
Rawtenstall	40,000	605,485	4,869,792	8·04	1·21	122	111	1,540	12/3	·79	1·121	·68	8·50	247·5	15	24
Rochdale ...	130,000	1,772,546	14,286,607	8·06	1·387	109·90	110·30	2,085	11/11	·78	1·07	·90	7·33	660	44	69
Rotherham...	64,000	E 850,548 RT ...	9,828,838 ...	11·55 ...	1·07 ...	153·6 ...	... ...	3,645 ...	13/1 ...	·72 ...	... ...	... ...	... ...	... ...	... ...	... ...
Salford ...	350,000	5,828,238	54,343,908	9·324	1·134	155	104	3,403	14/9	·78	2·20	·46	7·916	2,065·5	153	200
Southampt'n	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Southend ...	78,000	637,366	7,581,104	11·89	1·09	97·2	87	4,708	8/10	·634	1·41	·76	6·5	357	21	31
Southport ...	31,312	463,262	4,663,579	10·067	·94	148·62	98	1,710	11/5	·677	1·6	·62	6·65	825	15	26
So'th Shields	110,600	927,728	10,479,421	11·296	·899	91	126	3,826	7/1	·58	3·1	·38	7·71	285	20	40
Stalybridge	94,091	1,116,936	8,406,915	7·706	1·06	89·3	...	1,353	8/-	·905	1·22	·72	6·8	...	...	60
Stockport	120,000	1,490,116	...	...	...	...	...	2,356	11/2	...	...	..	..	...	...	...
Sunderland	170,000	1,486,201	18,619,364	13·2	·97	109·5	78·3	3,696	8/10	·536	1·34	·68	7	688	43	70
Swindon ...	53,000	223,383	2,392,470	10·71	·859	45·14	75	1,955	3/4	·709	1·2	·85	6	...	...	12
Wallasey ...	87,000	1,284,938	13,555,876	10·54	1·15	153·51	99·2	3,190	14/8	·75	1·89	·84	7	388·53	35·5	67
Walsall ...	100,000	720,634	6,752,727	9·371	1·184	68	94	1,905	6/7	·775	1·24	·79	7	315	21	39
Walth'mst'w	130,000	1,146,743	13,499,838	11·77	·732	103	104	3,089	6/4	·618	1·18	·86	7·6	430	37	38
Warrington	86,000	455,304	6,134,545	13·473	·909	71·332	102·423	2,406	5/5	·59	1·246	·803	6·401	194·86	12·179	21
West Ham ..	296,570	3,760,361	42,667,561	11·35	·852	144	90	5,041	10/-	·67	1·85	·80	7·66	1,195·75	93	118
W. Hartlep'l	90,000	479,382	4,261,917	8·89	1·07	47	94	2,163	4/3	·65	1·262	·94	7	203	14	26
Wigan ...	200,000	1,495,786	13,811,709	9·23	1·344	69	97·57	2,427	7/6	·802	1·15	·88	7·4	567	42	73
Wolverh'ton	135,000	1,181,309	12,236,785	10·359	1·06	90·64	89	2,539	8/1	·687	1·25	·879	6·85	651·6	36·2	52
Yarmouth ...	56,000	720,702	4,930,728	6·84	1·231	88·05	79	1,746	9/2	·857	1·25	·76	7	375	25	35
York	82,600	707,370	5,946,843	8·41	1·05	72	108	2,193	6/2	·73	1·33	·789	8	270	18	31

TABLE II.—TOWHS WITH SEPARATE CENERATIHC STATIONS FOR TRACTION.

Belfast ...	390,000	6,432,600	62,340,269	9·74	1·02	159	128	2,689	13/8	·60	1·96	·43	8·75	2,014	241	290
Bexley ...	16,500	316,970	2,270,070	7·16	1·55	133	126	2,922	19/10	1·24	1·59	·63	9·5	179	11	16
Birkenhead	137,996	1,209,117	14,822,697	12·25	1·052	107·41	73·46	2,702	9/3	·992	1·39	·66	6·84	483·81	45·09	65
Bournem'uth	120,000	1,962,352	17,182,844	8·76	1·46	143	95	3,505	17/5	·824	1·19	·87	6·8	1,140	60	81
Cardiff ...	182,729	2,742,846	30,424,407	11·09	1·09	166	85	4,358	15/2	·85	1·44	·736	7·5	1,408	88	130
Coventry ...	135,000	1,125,705	8,407,719	7·5	1·22	62	66	2,714	6/4	·831	1·18	·866	6·4	476	40	46
Glasgow ..	1,150,000	24,214,460	336,260,758	13·887	·764	292·4	105·61	5,404	18/7	·488	2·31	·44	8·11	8,974·78	628·20	856
Huddersfield	160,000	(a) 2,797,276	23,933,065	8·69	1·24	159	84	3,556	15/6	·73	1·34	·69	7·72	1,012·16	63·26	106
Hull	291,118	4,581,145	52,087,770	11·44	·745	178·92	123·43	4,879	11/1	·52	2·75	·364	9	1,565·60	97·85	180
Leeds ...	525,000	9,522,737	95,639,268	10·04	1·075	182	115·43	3,747	16/4	(b) ·884	1·93	·539	7·84	3,465	230	345
Leicester ...	232,644	4,137,262	37,914,773	9·146	·947	163	108·35	4,045	12/10	·751	2·18	·45	8	1,451	...	160
London ...	...	E68,706,161 H 272,631	547,253,332 3,244,661	9·32 11·90	1·02 ·76	...	117·07 77·12	8,465 1,045	... ...	·73 1·21	... ...	... ...	8·95 5·85	17,972 131·80	1,374 10	1,730 37
Newcastle ...	300,000	5,775,323	65,085,452	11·27	1·073	217	...	4,454	18/8	·592	1·58	·633	...	...	...	223
Northampt'n	91,500	690,177	8,295,941	12·02	·89	90·66	...	2,470	6/8	·603	1·34	·7	...	...	...	33
Portsmouth	246,000	2,438,621	27,554,194	11·299	1·061	112·01	90·29	3,535	9/1	·495	1·66	·62	7	1,065	74	100
Preston ...	120,000	1,025,738	10,340,688	10·08	1·04	86·17	132	2,652	7/7	·764	1·01	·95	7·36	404·7	21·3	33
Reading ...	76,500	924,696	8,881,097	9·6	·96	116	114	2,704	9/4	·54	1·59	·68	7·5	336	25	36
Sheffield ...	485,228	8,810,252	107,023,195	12·147	·878	220	108·86	4,950	16/2	·553	2·917	371	...	3,215·05	221·728	339
Wellington..	70,000	2,328,849	24,565,376	11·28	1·43	359	85	4,708	41/10	1·031	1·125	·69	7·89	840	75	92

E—Electric trolley system. H—Horse lines. (a) Including 9,467 miles coal haulage. (b) Total expenses per passenger.

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less English income-tax, instead of free of income-tax, as for the past three years.

Provincial Tramways Company.—The annual report is as follows: The net revenue received from the local companies has been £48,789, against £40,297 last year, and £41,683 in 1913. The amount of net revenue from local companies has been £48,789; add thereto amount brought forward, £4,935; transfer fees, £25; interest, £324; income-tax deducted from dividend warrants, £2,066, making £56,141—from which has to be deducted administration expenses, £1,745; income-tax, £2,083; Western Trust, Limited (trustee fee), £52; interest to the debenture holders for the year, £8,750; preference dividend for the year, £6,000; interim dividend on ordinary shares, £4,152; insurance, Grimsby, against aircraft and bombardment, £367. The directors have set aside to credit of reserve and depreciation account, £12,000; they have added to reserve account for third-party insurance or other purposes £4,000, leaving a balance of £16,990. The directors recommend that from the balance of £16,990 at their disposal a dividend be paid upon the £1 ordinary shares of 10d. per share, making, with 8d. per share paid in June, 1s. 6d. per share, a dividend of 7½ per cent. per annum for the financial year to September 30. The balance dividend upon the ordinary shares will absorb £5,190, and leave £11,800 to be carried forward.

CONTRACTS AND ORDERS.

Walthamstow Council are paying £1 2s. 10d. per ton for 300 tons of West Hallam small nuts.

Cardiff Corporation have placed contracts for coal at prices ranging from 14s. 2d. to 31s. 3d. per ton.

Preston Council have agreed to purchase a pair of jacks for each tramcar at an estimated cost of £270.

R. Hudson, Limited, Leeds, have obtained a contract for the supply of railway track to the War Department.

Leyland Motors, Limited, Lancashire, have been awarded a War Office contract for the supply of motor lorries.

Northampton Tramways Committee have accepted the tender of Hughes and Company for 1,200 tons of coal at 20s. 1d. per ton.

National Electric Construction Company, Limited, have submitted a scheme for enlarging the electricity works of Bo'ness Council.

Great Yarmouth Council have accepted the tender of Messrs. Cleeves and Company, London, for coal for the electricity works.

Sheffield Council have accepted the tender of W. Marlow & Sons, Limited, for the construction of the foundations for a turbo-alternator, at £2,199.

Manchester Corporation have placed a contract with the British Westinghouse Company for a 5,000 KW. turbo-alternator for the Stuart Street generating station.

Salford Council are obtaining a 18-22 H.P. Armstrong-Whitworth car for conversion into an ambulance van. Tenders for coal have been allotted at 15s. 3d. and 15s. 9d. per ton.

The Daimler Company, Coventry, have received a contract to supply three additional single-deck omnibuses to Walsall Tramways Committee, at £1,008 10s. each, inclusive of extras.

Glasgow Tramways Committee have accepted the tender of Fleming Brothers for trolley beams at Kinning Park sub-station, and of Charles Hamilton and Company for soft copper strip.

Edinburgh Council have placed a contract with Messrs. C. Brand and Son for the construction of shafts and tunnels for obtaining water from the sea for the condensing plant for Portobello power-station at £24,515.

Manchester Tramways Committee have accepted tenders by F. Smith and Company, Salford, for the supply of copper trolley wire, and by Edgar Allen and Company, Sheffield, for special track work, point tongues, and crossings.

Messrs. Colley, Meikle and Company, of Southampton Row, London, W.C., have been given an order for the heating and ventilating plant required for the third section of the central car repair depot of the London County Council at £1,495.

The British Thomson-Houston Company, Limited, of Rugby, about a year ago supplied to the Nuneaton Corporation a 750-KW. geared Curtis turbo-generator. This set has worked so satisfactorily since its installation that the Nuneaton Corporation have placed an order for a duplicate set to be delivered in the near future.

West Bromwich Council have placed contracts as appended:—Boiler and accessories, Babcock, Wilcox and Company, Limited; steel chimney, J. Thompson; economiser, E. Green and Son; feed pump, J. P. Hall and Sons; coal bunker, the New Conveyor Company; coal elevator, J. Proctor, Limited; switch-gear, British Westinghouse and Electric Manufacturing Company, Limited.

The Woods Gilbert Rail Planer Company, Limited, of Melbourne and London, has entered into a contract with the Adelaide Tramways Trust for the treatment of their rails, for grinding out corrugations and dished joints. The machine to be used is of an improved design, electrically driven, and fitted with double-headed grinding apparatus, similar to the machine placed by the same company on the Sydney lines. This improved type, which has proved successful in Australia, will be employed on some of the British tramways.

PERSONAL.

The Hon. A. G. Brand and **Mr. C. Patteman** have been re-elected directors of Norwich Tramways Company.

Mr. W. R. P. Marmion has been appointed general manager of Kalgoorlie Electric Power and Lighting Corporation.

Alderman J. H. Hargreaves, chairman of Hull Tramways Committee, has been re-elected for the third time as Lord Mayor.

Councillor Frederick A. Warlow, a director of Edgar Allen and Company, Limited, has been elected Lord Mayor of Sheffield.

Councillor F. Spashett, chairman of Lowestoft Tramways Committee, has been appointed by the Mayor to act as his deputy.

Mr. C. E. Crocker has been appointed general manager of Perth (Western Australia) municipal electricity and gas undertakings.

Mr. H. T. Wakelam, county engineer for Middlesex, has consented to act as hon. secretary and treasurer of the County Surveyors' Society.

Mr. W. H. Smith, of Simplex Conduits, Limited, has been appointed manager to that company for the Liverpool district and Ireland.

Mr. Frank Potter, general manager of the Great Western Railway, has been elected chairman of the General Managers' Conference for the year 1916.

Mr. T. O. Callender, managing director of Callender's Cable and Construction Company, has been added to the Commission of the Peace for the county of Kent.

Mr. H. J. Smith, resident engineer of Worcester Electric Traction Company, has been appointed manager of the Tynemouth and District Electric Traction Company.

Dr. R. J. Smith, who has been elected Lord Mayor of Cardiff, is a member of the Tramways Committee. In the face of considerable opposition, he took a leading part in carrying through the Council a scheme for advertising on the cars.

Mr. G. M. Gillett has been appointed a member of the Highways Committee of the London County Council to fill the vacancy caused by the resignation of Lord Monk Bretton.

Councillor John C. Mitchell, controller to the Allied Transit Companies of London, has been elected one of the two vice-presidents of the Institute of Secretaries for the ensuing year.

Mr. J. W. Dugdale, general manager, Oldham Corporation Tramways, has been complimented by the Mayor upon the excellent decoration made by his department at the Town Hall on the occasion of a visit of Lady Jellicoe, the wife of the Commander of the Grand Fleet.

Mr. B. G. Lamme, chief engineer to the Westinghouse Electric and Manufacturing Company, has been appointed a member of the Naval Advisory Board of the United States. Mr. Lamme has done considerable work in connection with the electrification of American railways.

Councillor R. Mayne, who has been appointed chairman of Newcastle Corporation Tramways Committee, had been vice-chairman for some years. He has always taken an important part in the deliberations of the committee, and is thoroughly familiar with the business of the tramways department.

Alderman F. A. Dunsford, J.P., has been re-elected chairman of the Southampton Corporation Tramways Committee. Mr. Dunsford has held this office continuously since the tramways were acquired by the Southampton Corporation, a period of seventeen years, and he is therefore easily the doyen of tramway chairmen.

Mr. E. Russell Taylor, in acknowledging his unanimous re-election as chairman of Liverpool Tramways Committee, remarked that they were passing through critical times, but with the continued co-operation of the members of the committee, they would face the situation with full confidence. Up to November 19 as many as 70 per cent. of the employees had either joined the forces or were working on munitions.

Norwich Tramways Company's Municipal Representative.—Mr. F. Fitzgerald, who presided at the annual meeting of Norwich Electric Tramways Company, stated that Mr. G. M. Chamberlin, who had represented the city on the board since 1896, retired at the expiration of his year of office, and the Corporation of Norwich having now the right under the Companies Act of last year, would appoint a director, subject to the approval of the directors. The board had always worked harmoniously with Mr. Chamberlin.

Praise for Auckland Officials.—In his remarks at the annual meeting of Auckland Tramways Company, the chairman (Mr. C. G. Tegetmeier) said he would like, as on previous occasions, not as a mere matter of form, but as a well-earned tribute of appreciation, to record the board's recognition of the services of their local directors, Mr. Hansen and Mr. Rhodes, and of the excellent work of the general manager, Mr. Walklate, and his staff. Successful working depended in a very large measure upon the men on the spot, and the company was fortunate in being particularly well served.

Ex-Bailie J. Alston, convener of Glasgow Tramways Committee, has passed away at his residence at Busby. He was appointed to the chairmanship only a few weeks ago after noteworthy service as vice-chairman. Mr. Montgomery, vice-chairman, has now been appointed convener, his vacated place being taken by Bailie Kelly.

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WITH THE FORCES.

Lance-Corporal J. T. Day, a clerk in Coventry Tramways department, was wounded during the landing at Suvla Bay.

Mr. J. Parry Brown, accountant to Newport Electricity and Tramways Committee, has been gazetted a lieutenant in the Army Service Corps.

Conductor H. Williams, who enlisted from Salford Corporation Tramways, has been home on special leave granted to him in France for an act of courageous conduct.

Captain H. A. Hammich, late of the British Westinghouse Works, Trafford Park, has been awarded the Military Cross for conspicuous gallantry at Helles, Gallipoli Peninsula.

Captain P. M. Moon, 4th Black Watch, was wounded in October. He is an engineer who, before the war, was engaged with Messrs. Balfour, Beattie and Company, London.

Sir George Gibb, the chairman of the Road Board, who a year ago was appointed to the War Office to supervise army contracts, has resigned the appointment. He is still a member of the Committee of Production.

Surveyors with the Forces.—Mr. J. Hanson, of Yorkshire, in his inaugural address as the new President of the Surveyors' Institution, announced that out of a total membership of five thousand, many of whom are not eligible for service, 1,387 are serving with the Army.

Mr. C. Burgess, general manager and engineer, West Hartlepool Tramways, has received permission to join the forces along with a number of the employees. The working of the tramways has been placed under the direction of the electrical engineer and borough engineer.

Sergeant W. R. Smethurst, 2nd Battalion Royal Sussex Regiment, formerly a motorman in the employ of Salford Corporation, has been awarded the D.C.M. Near Le Ruloire, on September 26, he rallied men who were falling back owing to a gas attack. He led them forward, thus assisting in the attack, in which he was wounded.

Conductor W. Chadwick, of the car that was overturned at Birmingham on November 13, was an army reservist and has served in South Africa and France. He was in the retreat from Mons, but sustained no injury until early in the year. Being unable to rejoin the permanent way department on account of his injury, he was given employment as a conductor.

Inspector Lee, Colchester Corporation Tramways, has been awarded the French military medal by the military authorities of France. The inspector, who has been serving with our forces in France for about a year, was presented with the medal by General Haig at a parade of the troops. The members of Colchester Corporation have passed a resolution of congratulation to Mr. Lee.

Sir John Courtis, chairman of Cardiff Tramways Committee, has rendered great service to wounded soldiers by undertaking the organisation during the past summer of a Cardiff detachment of the National Motor Volunteers. Their utility was demonstrated on November 13, when thirty cars, containing wounded men from Cardiff, arrived at a convalescent home which had been opened on the same day at Porthcawl. Sir John is also the honorary treasurer to the South Wales War Emergency Fund of the Y.M.C.A. This fund has provided more than a thousand club buildings for soldiers and munition workers in this country and abroad.

Lieutenant N. G. Crompton, of the Royal Engineers, who was killed in action on November 5, was the younger son of Colonel R. E. Crompton, of Thriplands, Kensington Court, who during the war has been prominently connected with the control of mechanical transport at the War Office.

Captain J. H. Courtis, eldest son of Sir John W. Courtis and Lady Courtis, of Cardiff, was killed in action in the advance on Bagdad between November 22 and 24. Captain Courtis, who was 27 years of age, passed from Sandhurst to the 1st Oxfordshire Light Infantry. He was serving in Burmah when war broke out, and was sent with the Expeditionary Force against the Turks in the Persian Gulf. In June, 1915, he was promoted captain and was appointed to General Sir John Nixon's staff shortly before his death.

Lieutenant Cecil G. Weitzmann, who until the outbreak of war was traffic superintendent of Para Electric Railways and Lighting Company, died from wounds in France at the end of September. At a memorial service, held in the Anglican Church at Para, on October 3, the Rev. A. M. Moss said Mr. Weitzmann was respected by all who knew him, and he ably discharged his duties in Para. From the first day of his arrival as chaplain, he rendered him generous assistance in establishing the little church. If he was in his element on the football field, he was no less so in his work in the office, a fact touchingly demonstrated by the presence at that service of a body of inspectors, motormen, and conductors. He was the first of the British community to volunteer and to lay down his life. Mr. C. B. Michell, the British Consul, also addressed the congregation. He stated that their deceased friend, although he bore a German name, was born an Englishman. The Consul read a letter from Mr. Walter Binns, the general manager of the company, referring in the highest terms to the lieutenant's eight years' service with the company, and to his example in encouraging the youth of Para to learn manliness on the field.

TRAMWAY CHAIRMEN FOR 1915-16.

Municipal Tramways Committees have now been constituted for the ensuing year, and we append a list of chairmen and vice-chairmen. An asterisk indicates that the chairman or vice-chairman has been newly appointed.

Town.	*Chairman.*	*Vice-Chairman.*
Aberdare	*Councillor E. Stonelake.	
Aberdeen	Councillor R. Robertson.	
Accrington	Alderman Higham	Councillor Morley.
Ashton-under-Lyne	Alderman R. S. Oldham	Alderman Waterhouse.
Ayr	Councillor J. R. Learmont	Bailie Murray.
Bacup	Alderman Sir H. Maden	Councillor J. H. Lord (Mayor).
Barking	Councillor D. Gordon.	
Belfast	Alderman J. Tyrrell	Councillor Jas. A. Duff.
Birkenhead	Councillor H. Halsall	Councillor R. Frame.
Birmingham	Councillor H. Barrow.	
Blackburn	Alderman W. Thompson	Councillor C. Higham.
Blackpool	Alderman Brodie	Alderman R. Holt (Mayor).
Bolton	Alderman Miles	Councillor P. Higson.
Bournemouth	Councillor Bell	Councillor McCabe.
Bradford	Councillor Priestley.	
Brighton	*Councillor Martin.	
Burnley	Councillor E. Heap	Councillor Irving.
Burton-on-Trent	Alderman J. S. Rowland (Mayor).	
Bury	Alderman Collinge	Councillor Hargreaves.
Cardiff	Alderman Sir J. W. Courtis	Councillor A. J. A. Stone.
Chester	Alderman J. Jones	*Councillor A. S. Dutton.
Chesterfield	Alderman Shentall (Mayor)	Councillor Woodhead.
Coventry	Councillor Pugh	Councillor Wale.
Croydon	Alderman G. J. Allen	*Councillor Thomson.
Darlington	Alderman C. W. Starmer.	
Dartford	*Councillor R. Bennett	*Councillor J. B. Walton.
Darwen	Alderman J. Tomlinson	Councillor G. P. Holden.
Dover	*Councillor Barwick	*Councillor Norman.
Dundee	Councillor G. A. Johnston.	
East Ham	Alderman M. Oakes.	
Erith	Councillor G. C. Humphreys.	
Exeter	Alderman H. B. Varwell	*Councillor F. G. Towill.
Glasgow	*Councillor Montgomery	*Bailie Kelly.
Great Yarmouth	Councillor J. T. C. Salmon.	
Haslingden	Councillor Waddington	Councillor Haworth.
Heywood	Councillor J. Ashworth	Alderman T. Popple.
Hull	Alderman J. H. Hargreaves (Lord Mayor)	Councillor W. Wheatley.
Ilford	Councillor W. J. T Cullis	Councillor O. Waters.
Ilkeston	*Councillor J. E. Bestwick	*Councillor Kane.
Keighley	Councillor A. Smith.	
Kilmarnock	Bailie Jones.	
Kirkcaldy	Councillor G. Fergusson.	
Lancaster	Councillor T. Wilkinson.	
Leeds	Alderman R. A. Smithson	Alderman H. Brown.
Leicester	Alderman S. Flint	Alderman G. Banton.
Leith	Judge Hall.	
Leyton	*Councillor J. A. Hennah.	
Lincoln	Alderman W. S. White.	
Liverpool	Councillor E. Russell Taylor	Alderman F. Smith.
Lowestoft	Councillor F. Spashett.	
Maidstone	*Alderman Vaughan	Councillor Green.
Manchester	Alderman J. Bowes	Alderman A. W. Chapman.
Nelson	Councillor W. F. Cooke.	
Newcastle-on-Tyne	*Councillor R. Mayne.	*Councillor A. M. Sutherland.
Newport	Councillor J. Moxon	Alderman F. Phillips.
Northampton	Councillor T. D. Lewis	Councillor W. Beale.
Nottingham	Councillor R. H. Swain	Alderman F. R. Radford.
Oldham	Alderman F. G. Isherwood	*Councillor F. Elliot.
Perth	Councillor Calderwood.	
Pontypridd	*Councillor M. L. Jones	
Preston	Alderman J. Ormrod	Councillor T. Parkinson.
Radcliffe	Councillor W. Allen.	
Rawtenstall	Alderman H. Coupe	Councillor J. W. Stansfield.
Reading	Alderman C. G. Field (Deputy Mayor).	
Rochdale	Alderman Taylor	
Rotherham	Alderman D. L. Winter	Councillor T. Reeves.
Salford	Alderman H. Linsley	Councillor W. H. Barrett.
Sheffield	Alderman Sir W. Clegg	Councillor A. T. Bescoby.
Southampton	Alderman F. A. Dunsford.	
Southend.	Alderman A. Martin.	
Southport	*Alderman Griffiths	*Councillor Clayton.
Stalybridge	*Alderman R. Wood	*Councillor S. C. Homer.
Stockport	Alderman C. Sharples	Alderman W. E. Hamnett.
Sunderland	Councillor G. New	Councillor W. Walker.
Swindon	*Councillor A. D. Richards	*Councillor A. Bull.
Wallasey	Councillor F. E. Howse	Councillor H. W. Griffin.
Walsall	Alderman J. Cope	Alderman J. Williams.
Walthamstow	Councillor W. R. Clarke.	
Warrington	Councillor Dr. G. W. Joseph	Councillor J. Wilkinson.
West Ham	Alderman H. W. Littler.	
West Hartlepool	Alderman Martin	Councillor Charlton.
Wigan	Alderman Fletcher	Councillor J. Walkden.
York	Alderman S. W. Meyer	*Councillor W. H. Sessions.

TAXATION OF EXCESS PROFITS.

Sheffield Corporation have requested the Association of Municipal Corporations to arrange for a deputation to the Chancellor of the Exchequer on the subject of the refusal of the House of Commons to exclude municipal corporations from the operation of the excess profits clauses of the Finance Act. It is proposed to point out that whilst an industrial or trading concern was allowed to take into account all departments, some of which might be profitable and others unprofitable, before arriving at the amount on which excess profits must be paid, a Corporation would have to treat the tramway, electricity, and water undertakings as separate departments. It is contended that this would be unfair, and would inflict great hardship. Attention is to be called to the large sums that Corporations are paying to the dependents of employees serving with the forces, and a request will be made that such expenses should be taken into account. It is also proposed to refer to the assistance rendered to the Government by Corporations in providing hospitals and in many other ways.

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TRAMWAY AND LIGHT RAILWAY NOTES

ABERDEEN.

THE P.A.Y.E. CARS.

Now that women conductors are employed on the Aberdeen cars it must every day be manifest that the Council acted unwisely in listening to the clamour that brought about the discontinuance of the P.A.Y.E. Company's prepayment system. In all the great towns where the aid of women has been adopted on the cars appeals have been made to passengers to pay their fares on the platform whenever possible. This course is rendered easier of adoption on the more commodious platforms fitted to thirty-one of the Aberdeen cars for prepayment purposes. Having in mind the employment of women as conductors, the P.A.Y.E. Company recently asked the Corporation to reconsider the decision arrived at nearly two years ago to discontinue the use of the company's patents. Although the Tramways Committee have not acceded to the suggestion, they have rejected a proposal to alter the prepayment cars back to their original design. The manager had reported that the cost of rearranging the staircases and doing away with the front exit would be £12 10s. per car.

BRADFORD.

LABOUR SHORTAGE AND PRESSURE OF TRAFFIC.—DEPENDENTS' ALLOWANCES.

The Tramways Committee on November 22 considered the report presented by Mr. C. J. Spencer, the general manager, on the difficulty of maintaining the services in consequence of recruiting having caused a shortage of labour. Curtailment of the service, the manager said, would temporarily meet the shortage of labour, but it would be at the expense of national interests, public convenience, and finance. From early morning to 9 a.m. the cars were crowded to excess, and in order to meet that demand 153 cars had to be manned and maintained. The cars could be stopped at 9 p.m., but that would only shut down a proportion of the expense. In view of the peculiar conditions in Bradford he would not willingly advise the employment of females, but the only alternative was to greatly curtail the services. The members seemed to be in agreement that female conductors were not desirable in view of the many steep gradients, and the manager was asked to report on his suggestion of employing men not of military age or fitness if they are available, and also the feasibility of issuing books of tickets to the public in order to lessen the work of the conductors. The department have made progress with the work of reducing the number of stopping-places on the tramways. In order to prevent the tramways department being made use of simply to secure allowances for dependents, a rule has been in force that men who enlist must have been in the employ of the Council for three months. As an additional safeguard the committee have directed that all applications for the allowance shall be brought before the Corporation.

EDINBURGH.

RECOGNITION OF LOYAL SERVICE.—INCREASES IN FARES.—CONDITION OF THE TRACK.

In appreciation of the work of the employees of Edinburgh and District Tramways Company during a period of strain due to shortage of labour since the outbreak of the war, the directors have increased the wages of all classes 2s. per week. Certain concessions have also been made with regard to holidays. The addition to the expenditure will amount to £3,500 per annum. In order to meet the great rise in prices of all commodities and of wages, the Tramways Company have increased the fares. The increases are strictly in terms of the lease from the Corporation. In many instances a half-penny has been added to the penny stages. A deputation from the directors informed the Tramways Committee that the total advance in the costs of coal, cables, etc., was about £25,000, and in addition the company are paying allowances to the dependents of employees engaged at the front. The deputation offered to retain the fares at the present rate provided the Corporation guaranteed them the same rate of profit as in the last three years, or reduced the rent. The increased fares would amount to 8 per cent. on a turnover of £310,000 per annum, and would only affect about one-fifth of the passengers. The through fares to Leith have also been discontinued by the company, who, however, offered to continue them if the company would obtain a penny for a penny distance. Leith Tramways Committee have decided to take no action. An intimation was given to the company on November 24 by the Tramways Committee that they are not satisfied with the condition of the track, although the company had assured them that the manager was doing his best consistent with the dearth of labour. The committee also called attention to the frequency of breakdowns.

DUNDEE.

BADGE FOR INVALIDED SOLDIERS.

In applying to Dundee magistrates for licences for seven invalided soldiers to act as car conductors, the tramways manager showed the Bench the badge now worn by discharged soldiers in the tramways service.

GLASGOW.

TRAMWAYS DEPARTMENT AND RECRUITING.—SUGGESTED USE FOR TRAMWAY SURPLUS.

Under Lord Derby's recruiting scheme the Corporation tramways offices continue to be one of the chief centres for the enlistment of recruits. The tramways employees have again provided their quota for immediate and also for deferred service. Extra animation and enthusiasm is imparted to the scene outside the offices by the performances of the Tramways Band and by the bands of other local institutions. The Lord Provost recently announced that in addition to sending nearly three thousand tramways employees to the colours, the department had enlisted upwards of 12,000 men as the result of the campaign carried out by the tramways manager and his assistants. At the Government inquiry into the housing problem for munition workers at Glasgow, the Labour Party asked for a loan free of interest from the tramways surplus fund, known as the Common Good, to build houses.

HULL.

ACCIDENTS DUE TO RESTRICTED LIGHTING.

The Tramways Committee were presented on November 24 with a number of reports of accidents and claims arising from the curtailed lighting of the city. The Lord Mayor did not favour any representation being made to the military authorities, but he agreed, at the committee's request, to call on the General and submit an application for improved lighting. One of the members stated that under the system of alarm at Hull there was a quick response on the part of the public in extinguishing lights.

LEEDS.

TRAFFIC PERIODS.—PRAISE FOR WOMEN CONDUCTORS.—EMPLOYEES WITH THE FORCES.

A considerable part of the increased traffic on the Leeds cars is due to the pressure of work in the factories and the extension of the "shift" system in many munition works. Thousands of munition workers, both men and women, start work at 6 a.m., 2 p.m., and 10 p.m., on the three shifts a day system. Cars going to the woollen mills at Stanningley are crowded with women at 5 a.m. Of the women conductors who were introduced on the cars towards the end of October it is reported that they do their work quietly and quickly, and their presence has enabled more men to enlist. Up to October 31 39 tramway officials and 634 employees were with the forces, out of a total of 412 officials and 1,235 men sent from the various departments of the Corporation.

LEICESTER.

INCREASED FARES JUSTIFIED.—EXTRA GENERATING PLANT.

Referring to a petition received against the increased fares at Leicester, Alderman S. Flint, chairman of the Tramways Committee, has stated that the new fares have been more than justified by the returns. The Corporation have authorised the Tramways and Electricity Committee to instal two additional tubular boilers at the generating station, at an estimated cost of £11,520, the payment of the cost to be made out of the reserve fund of the tramways undertaking.

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NEWCASTLE-ON-TYNE.

CARS CEASE RUNNING AT 9 P.M.—CONCENTRATION ON WORKMEN'S TRAFFIC.

The City Council have rejected a motion to discuss the action of the Tramways Committee in curtailing the service to 9 p.m. Councillor R. Mayne, chairman of the committee, said they had not intended to bring the manager's altered scheme of running hours before the Council, as it did not indicate any change of policy, but was an urgent administrative alteration to meet abnormal conditions brought about by the difficulties of driving long hours in the darkness, by the shortage of men, and by the necessity for a much greater service of cars at given hours. Mr. Mayne has since stated that over 1,000 hands have been trained in the last twelve months, and only 300 are remaining in the service. The other 700 have obtained employment in munitions or have enlisted. The secretary of the employees' union, who is himself one of the voluntary motormen who assist with the workmen's traffic in the early morning, states that the men are heartily in accord with Mr. E. Hatton, the manager, in concentrating on the workmen's traffic. The scheme was submitted to the men's delegates. The introduction of the single shift had given twice as many workers to the undertaking, with the result that the early traffic has been coped with in a highly satisfactory way. On December 1, the chairman of the Tramways Committee undertook to consider whether a better service could be given at night.

SHEFFIELD.

LATE SERVICES CURTAILED.—TRAFFIC PRESSURE.—WOMEN CONDUCTORS' ENTHUSIASM.

In issuing notices giving the earlier times for the departure of the last cars, Sheffield Tramways department have asked the public to assist them by refraining as far as possible from using the last car on the various routes. Owing to the running of so many cars for workers the terminal point for the Sheffield-Rotherham cars will be in Bridge Street. This is necessary in order to afford relief to the tramway traffic in Fitzalan Square, the city terminus. On the Rotherham tramways the increased traffic amounts to about 20 per cent. without taking into consideration the passengers carried by the motor omnibuses and railless trolley cars. In describing the activities of Sheffield at 5 a.m., a local writer pays a tribute to the young women who act as conductors on the workmen's cars. "To see the lines of loaded cars on their outward journey is in itself an object lesson," he says, "but even that sight sinks into insignificance before the other one of the incoming cars, crammed to the brim with tired toilers, men sitting on each other's knees and standing two or three deep." This pen picture should be noted by the heads of the metropolitan police, who labour under the delusion that London is the only place where heavy traffic is to be seen. Sir Wm. Clegg, chairman of the Tramways Committee, explains the curtailment of the service as being due to the strain placed upon the decreased number of men by overtime and by driving in the darkened streets. It was probable that further reductions would have to be made in the ordinary service in order to provide more cars for munition workers. He suggested that ladies engaged in shopping should avoid using the cars at one o'clock and between 5 and 7 p.m.

YORK.

WARNING AGAINST LOW FARES AND PASSES.

A York Corporation Committee, appointed for the purpose of recommending economies during the war, have reported that the conditions of the tramways compare favourably with those in Darlington, Doncaster, Halifax, Huddersfield, Keighley, and Rotherham. "The traffic receipts in York," the committee state, "appear to be low, viz., 8·85d. per car-mile, against an average of 10·41d. The committee recommend the Council to instruct the Tramways Committee to give these figures careful consideration. They would appear to show that the number of reduced fares or free passes has been unduly extended."

Yorkshire Tramway Managers' Association.—A meeting of this Association was held on November 18, at Sheffield, when the following members attended:—Messrs. A. R. Fearnley (Sheffield), W. J. McCombe (Hull), P. Priestly (Mexboro' and Swinton), J. W. Hame (York), W. McGibbon (Ossett), E. Parkinson (Dewsbury), E. A. Paris (Dewsbury), W. F. Nicoll (Scarborough), H. L. White (Grimsby), J. V. Moinet (Scarborough), C. J. Jewell (Wakefield), and R. L. Acland (Chesterfield). Letters of apology for non-attendance were received from Messrs. J. D. Caird and J. W. Galloway (Halifax), R. H. Wilkinson (Huddersfield), J. B. Hamilton (Leeds), and H. England (secretary, Wakefield). After luncheon an interesting discussion took place on many subjects, including trolley accidents, employment of women conductors, bow trolleys, design and maintenance of section boxes, etc. The members then boarded a motor-omnibus (kindly provided by Mr. Fearnley) and proceeded to Messrs. Edgar Allen and Company's works, where a tour of inspection was made, particular attention being directed to the new types of points and special work manufactured by the company and then under construction. Tea was kindly provided at the works, and before leaving votes of thanks were accorded to Mr. F. Bland, of Messrs. Edgar Allen and Company, and to Mr. A. R. Fearnley.

PATENT LIST.

Specially abstracted for "The Tramway and Railway World" from the Official Journal of Patents.

*** If the inventions have been communicated the names of the communicators are given below in italics.

APPLICATIONS FOR LETTERS PATENT.

15,384 Car brakes—O. W. Allison.
15,586 Train stops—B. R. Roach.
15,627 Motor-driven vehicles with belt transmission—J. J. J. Rauscher and P. A. Debroutelle.
15,715 Systems of power transmission—W. R. Kimball.
15,720 Spring wheels for road vehicles—H. B. Woolley.
15,740 Electric overhead tramcar trolley—W. Cayless.
15,916 Bogies for railway vehicles—T. F. Craddock (*Burn and Company, Limited,* and *Alfred Craven*).
15,971 Trolley collectors for overhead wire tramways and railways—P. W. Steele.
15,980 Self-propelled vehicles—G. Watney.
16,030 Locomotives, railway motor cars, etc.—E. E. Baguley.
16,092 Self-propelled vehicles—J. Landon and F. W. Martyn.

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AILSA OILSKINS
Give Genuine Satisfaction.
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The Manager of a well-known tramway company writes:—"Past results have been so satisfactory that we have this year decided to place the whole of our order in your hands."

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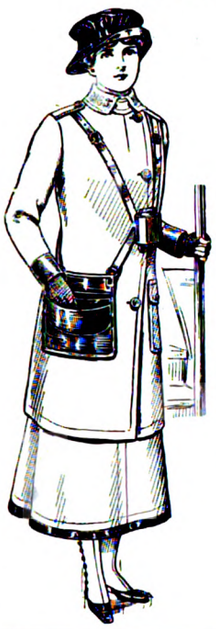
TO H.M. WAR OFFICE, H.M. COLONIAL OFFICE, INDIA OFFICE, ST. JOHN AMBULANCE ASSOCIATION, BRITISH RED CROSS SOCIETY, LONDON COUNTY COUNCIL, GUY'S HOSPITAL, &c.

SPECIAL DESIGNS FOR

Women Tramway Conductors & Drivers



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Railway Ticket Inspectors

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2 GUINEAS each

Special Reduction for Quantities of 100 and over. Sample Garment sent for inspection.

A LARGE ORDER for Coats and Skirts has just been completed for

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16,158 Wheels and axles—A. R. H. Baveystock.
16,295 Chassis for motor road vehicles—E. Raulet, L. Loiseau, and others.
16,307 Illuminating devices for ticket punches—A. W. Kingston.
16,324 Resilient wheel for road vehicles—S. Frais.
16,353 Coupling device for the vestibules of corridor rolling-stock for railways—W. H. Tinson.
16,414 Signalling device for road junctions—M. E. Walsh.
16,461 Motor vehicles—Clayton and Shuttleworth, P. W. Robson and F. J. Bretherton.
16,514 Motor vehicles—G. Waddell.
16,601 Rail-tie structures—M. E. Smith.
16,609 Motor lorry wheels—G. H. Robinson.
16,632 Tramway tickets—J. Newey.
16,721 Vehicles—British Thomson-Houston Company. (*General Electric Company*).
16,732 Self-propelled vehicles—G. Watney.
16,757 Motor vehicles—W. T. Bell and L. W. Jones.
16,765 Apparatus for electrically lighting railway vehicles—G. D. Peters and Company, F. C. Hibberd, and W. King.

Specifications Published.

1914.

20,657 Speed indicating device for use in automobile vehicles—Mousseau.
22,062 Electric generators for lighting mechanically-propelled vehicles—Smyth.
23,177 Wheels of motor road vehicles—Morgan.
21,088 Automatic safety apparatus for railways—Barnes Train Stop Company, and Barnes.
22,562 Wheel-guards for motor vehicles—Heard.
21,406 Control systems for railways—Cowell and McCaughan.
21,944 Motor road vehicles—Richardson.
23,244 Suspension of trucks of tramway vehicles—Peckham and Thomas.
22,302 Braking apparatus for railway and tramway vehicles—Rendell.
22,944 Car trucks—Adams.

1915.

157 Tires for the wheels of road vehicles—Kerslake.
343 Base plate for railway or tramway sleepers—Sandberg.
1,429 Heating systems for motor road vehicles—Van Ruymbeke.
6,715 Electric generators for lighting mechanically-propelled vehicles—Smyth.
11,139 Switch device for car lighting and like dynamos—Albion Motor Car Company and Murray.
180 Electric starting devices for motor-driven vehicles—Maschinenfabrik Oerlikon.
10,547 Rail joints—Schoelerman.
11,891 Railway sleepers and means for securing the rails thereto—Carey.
9,682 Electrically-operated change-speed gear—Oesterreichische-Daimler-Motoren Akt.-Ges.
10,915 Motor vehicles—Daimler-Motoren-Ges.

Colonial and Foreign Tramways Traffic Returns.

NAME OF COMPANY.		1914. WEEKS ENDED.					1915. WEEKS ENDED.					AGGREGATE.		
		Nov. 7.	Nov. 14.	Nov. 21.	Nov. 28.		Nov. 6.	Nov. 13.	Nov. 20.	Nov. 27.		Wks.	1915.	Increase or Decrease.
		£	£	£	£		£	£	£	£	£		£	£
Anglo-Argentine		52,400	52,884	52,459	50,763	...	54,194	53,091	51,294	52,407	...	47	2,397,085	−134,417
Auckland		...	...	...	...	...	...	...	...	...	...	...	...	...
Burma	Rs.	3,724	3,333	3,153	3,608	...	3,964	4,235	4,241	3,810	...	...	64,241	+ 5,564
Calcutta	Rs.	63,686	60,079	60,822	57,394	...	60,188	62,550	61,534	68,355	...	47	3,092,306	− 48,567
Hong Kong	$	...	...	...	...	...	...	...	...	...	...	...	...	...
Madras	Rs.	(14 days)	22,639	(14 days)	24,558	..	(14 days)	29,441	(14 days)	25,837	...	46	644,161	+ 33,427

Companies Issuing Monthly Statements.

		1914.						1915.						Wks.	AGGREGATE.	
		May.	June.	July.	August.	Sept.	October.	May.	June.	July.	August.	Sept.	October.		1915.	+ or −.
		£	£	£	£	£	£	£	£	£	£	£	£		£	£
Brazilian Street Mlrs.		...	...	...	...	...	...	...	...	...	...	...	...	...	—	—
BrazilianTraction Mlrs		6,180,830	6,188,900	6,462,860	6166100	6096940	6,241,170	6,670,110	6,591,940	6,703,000	6576000	6494000	6,793,000	44	64,250,110	+2,838,852
Brisbane		29,860	28,590	29,660	33,172	28,031	28,763	31,780	29,880	31,150	35,064	30,360	31,880	44	306,954	+ 18,333
British Columbia	$	678,314	660,383	690,023	674,812	650,516	661,000	512,568	498,093	510,723	507,126	517,022	538,826	18	2,073,697	− 602,654
Buenos Aires Pt. & C.		...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Buenos Ayres Lacroze		...	...	43,328	40,508	40,333	42,341	...	...	41,460	41,468	39,355	42,516	17	164,799	− 1,711
Cape Town		...	...	...	...	...	...	...	...	13,960	...	13,310	...	—	—	—
Carthagena& Herrerias		2,202	1,405	2,416	2,758	2,175	1,543	1,931	2,059	2,157	1,523	1,252	2,169	44	17,749	− 4,939
Cordoba		14,667	13,974	14,165	13,371	12,384	...	14,458	14,091	14,373	14,157	13,213	...	26	83,905	+ 1,938
East India		1,885	1,966	2,045	2,112	1,980	2,007	2,119	2,194	2,231	2,266	2,054	2,069	13	6,389	+ 290
Kalgoorlie		3,025	2,692	2,552	3,042	2,864	...	3,269	2,707	2,775	3,165	2,997	...	39	25,116	+ 1,136
La Plata		4,727	4,560	4,358	4,060	3,598	4,540	4,489	3,876	4,055	4,165	3,894	4,405	44	42,291	− 4,101
Lima		33,215	33,499	34,627	29,898	28,717	30,646	31,700	31,650	33,344	32,011	30,543	32,208	44	320,466	− 10,603
Manila	$	138,600	132,500	133,900	128,500	116,300	125,750	120,475	116,875	123,750	126,650	123,946	124,131	44	1,224,155	− 115,675
Melbourne		...	...	..	...	...	...	...	...	63,432	...	...	...	—	—	—
Mexico	$	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Montevideo ...		29,016	28,049	26,417	26,075	25,226	26,500	27,771	24,266	25,161	26,493	25,070	27,167	52	330,584	− 30,881
Port Elizabeth		...	...	...	...	...	...	...	...	3,362	...	2,927	...	—	—	—
Puebla	$	...	...	...	...	...	...	...	...	...	...	...	...	—	—	—
Rangoon ...		5,323	4,997	4,975	4,629	4,119	4,600	4,887	4,997	4,629	4,510	4,445	4,886	44	48,215	− 2,442
Toronto	$	871,733	861,938	866,221	850,639	879,321	849,636	795,262	787,558	773,013	762,627	804,902	792,001	44	7,942,606	− 529,137
Winnipeg ...	$	337,664	335,012	346,630	322,762	310,996	330,562	263,302	255,549	248,022	251,189	261,982	286,146	44	2,799,595	− 602,907

(*Continued on page 474*)

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TRAFFIC RETURNS—*continued.*

Tramways and Omnibus Undertakings in the United Kingdom.

NAME OF COMPANY OR CORPORATION.	1914. WEEKS ENDED.				1915. WEEKS ENDED.				AGGREGATE.		
	Nov. 7	Nov. 14	Nov. 21	Nov. 28	Nov. 6	Nov. 13	Nov. 20	Nov. 27	Wks.	1915.	Increase or Decrease.
	£	£	£	£	£	£	£	£		£	£
Aberdeen Corporation	1.601	1.728	1.471	1.465	1.838	1.861	1.607	1.573	14	45.994	+ 2.483
Accrington Corporation	431	477	435	415	510	504	504	479	34	19.061	+ 344
Ayr Corporation	224	231	206	221	239	251	229	224	28	11.827	+ 638
Bath Electric	*	...	...	...	...	...	...	...	—	—	—
Birkenhead Corporation	1.216	1.199	1.115	1.180	1.317	1.362	1.285	1.232	34½	47.742	+ 3.810
Birmingham Corporation	12.408	12.009	11.591	11.734	15.218	15.369	15.259	14.780	35	489.818	+ 67.704
Blackburn Corporation	1.089	1.022	1.017	949	1.100	1.079	1.065	1.004	35	45.384	- 305
Blackpool and Fleetwood	422	283	290	267	425	292	284	248	47	37.542	- 274
Blackpool Corporation	766	558	522	512	696	662	610	588	35	65.514	+ 1.514
Bolton Corporation	2.507	2.454	2.329	2.387	2.599	2.581	2.460	2.402	35	93.661	- 1.910
Bournemouth Corporation	1.663	1.693	1.577	1.653	1.728	1.733	1.559	1.586	35	76.392	+ 3.617
Bradford Corporation	5.828	5.936	5.430	5.615	6.482	6.020	5.856	5.739	34	227.315	+ 9.618
Brighton Corporation	936	846	767	778	951	918	844	814	34½	40.394	+ 252
Bristol	8.263	7.926	7.646	7.680	9.651	9.718	9.596	9.634	47½	451.173	+ 45.649
Burnley Corporation	1.394	1.305	1.255	1.236	1.492	1.488	1.424	1.404	35	55.888	+ 883
Burton-on-Trent Corporation	284	276	244	267	269	282	258	244	35	9.865	- 422
Bury Corporation	1.199	1.151	1.100	1.104	1.252	1.237	1.147	...	33½	46.564	- 564
Cardiff Corporation	2.523	2.441	2.257	2.342	2.452	2.539	2.392	2.388	34	93.729	- 2.726
Chatham and District	1.036	1.033	908	886	1.082	1.070	988	969	47	54.880	+ 9.430
Chesterfield Corporation	247	244	235	231	248	260	256	249	34	9.306	- 5
Colne Corporation	220	...	...	204	238	...	...	210	...	—	—
Cork Electric	459	475	444	424	461	473	441	425	47	23.639	+ 25
Croydon Corporation	1.652	1.583	1.469	...	1.585	1.569	1.514	...	34	62.513	+ 4.130
Derby Corporation	943	974	905	894	979	1.054	979	917	34½	36.555	+ 1.058
Dover Corporation	239	220	201	197	278	277	248	252	34	11.052	+ 1.998
Dublin and Lucan	114	120	112	105	126	115	103	99	21	3.275	+ 90
Dublin United	5.892	5.640	5.368	5.364	5.784	5.874	5.513	5.351	47	287.405	+ 10.693
Dundee City	1.241	1.265	1.178	1.186	1.354	1.388	1.266	1.230	27½	37.982	+ 2.063
East Ham Corporation	1.212	1.204	1.148	1.161	1.195	1.247	1.217	1.202	34½	45.445	+ 5.787
Exeter Corporation	323	318	283	276	333	347	304	292	34	13.305	+ 780
Gearless Motor Buses	*	...	...	...	...	...	...	...	—	—	—
Glasgow Corporation	20.495	20.227	18.891	19.571	21.877	21.794	19.687	20.261	26	560.253	+ 40.310
Glasgow Subway Railway	1.036	1.034	1.024	1.038	1.156	1.192	1.301	1.242	47	50.032	+ 1.538
Glossop (Urban Elec. Supply Co.)	100	99	90	91	122	123	121	119	48	6.021	+ 230
Halifax Corporation	1.994	2.104	1.841	1.854	2.040	2.061	1.914	1.878	34	77.583	+ 997
Hastings and District	804	851	722	661	761	789	706	674	47	66.368	- 166
Huddersfield Corporation	2.395	2.353	2.137	2.199	2.440	2.512	2.392	2.357	34	93.465	+ 13.179
Hull Corporation	3.015	2.984	2.897	2.932	3.139	3.104	3.084	3.088	34	105.575	- 3.024
Ilford U.D. Council	600	578	555	548	590	585	574	565	34	22.559	+ 2.899
Ilkeston Corporation	121	116	114	114	125	136	121	117	35	4.739	+ 153
Ipswich Corporation	406	387	346	348	473	479	445	432	33	19.376	+ 3.114
Isle of Thanet	357	305	258	253	250	248	218	211	8	2.246	- 793
Kilmarnock Corporation	152	151	137	142	153	156	147	143	28	4.775	+ 146
Lanarkshire	1.709	1.741	1.622	1.598	2.144	2.019	1.903	1.803	47	93.194	+ 5.063
Lancashire United	1.511	1.487	1.415	1.358	1.613	1.596	1.537	1.501	47	81.852	+ 5.145
Leeds City	8.064	8.016	7.436	7.825	8.735	8.748	8.437	8.206	35	311.630	+ 24.585
Leicester Corporation	2.812	2.774	2.729	2.664	3.009	3.196	3.027	2.957	48	143.987	+ 8.448
Leith Corporation	715	676	613	624	738	728	670	661	28	21.800	+ 1.325
Leyton U. D. Council	1.400	1.409	1.331	1.296	1.409	1.471	1.458	1.426	34	55.947	+ 7.475
Liverpool Corporation	12.936	12.655	11.703	12.113	12.872	13.052	12.505	12.383	47	630.194	+ 9.063
Llandudno and Colwyn Bay	163	159	148	143	213	190	187	171	52	17.294	+ 1.787
London County Council	*	...	...	...	...	...	...	...	—	—	—
London General Omnibus	*	...	...	...	...	...	...	...	—	—	—
London United	*	...	...	...	...	...	...	...	—	—	—
Lowestoft Corporation	198	181	161	160	131	129	120	120	8½	1.057	- 473
Maidstone Corporation	192	181	159	149	187	192	179	168	34	7.705	+ 202
Manchester Corporation	16.938	16.673	15.504	16.399	17.151	17.455	16.344	16.006	34	620.265	+ 19.737
Metropolitan Electric Tramways	*	...	...	...	...	...	...	...	—	—	—
National Steam Car	*	...	...	...	...	...	...	...	—	—	—
Nelson Corporation	141	148	128	163	173	187	174	187	34½	6.816	+ 208
Newcastle-on-Tyne Corporation	5 869	5.636	5.364	5.586	6.374	5.799	5.596	5.597	34	218.722	+ 28.486
Newport (Mon.) Corporation	752	735	686	696	773	814	752	735	35	29.120	+ 367
New St. Helens and District	830	859	806	754	902	901	882	846	21	22.689	+ 2.437
Northampton Corporation	608	574	592	572	635	664	629	592	34	25.363	+ 4.637
Nottingham Corporation	3.344	3.325	3.166	3.087	3.478	3.635	3.559	3.433	34	128.324	+ 8.919
Oldham Corporation	1.954	1.891	1.836	1.891	2.148	2.123	2.006	1.928	36	82.486	+ 3.464
Portsmouth Corporation	2.223	2.086	1.857	1.791	2.126	2.066	1.960	1.908	35	88.871	—
Preston Corporation	859	886	809	793	941	934	927	906	34	33.076	+ 1.002
Provincial	2.020	1.920	1.792	1.748	2.036	2.018	1.945	1.877	8½	17.190	+ 989
Reading Corporation	675	646	610	585	723	759	714	679	34	27.334	+ 2.848
Rhondda Tramways	1.142	1.148	1.102	1.046	1.166	1.194	1.160	1.100	47	55.647	- 2.173
Rochdale Corporation	1.460	1.457	1.350	1.398	1.573	1.582	1.471	1.410	34½	59.722	+ 2.650
Rotherham Corporation	950	924	918	950	1.196	1.174	1.140	1.138	35	40.992	+ 4.646
Salford Corporation	4.756	4.527	4.351	4.982	4.928	4.919	4.657	4.585	34½	181.779	+ 6.606
Sheffield Corporation	7.821	7.525	7.281	7.511	9.275	9.300	9.085	8.936	35½	317.570	+ 43.447
Southampton Corporation	1.246	1.186	1.098	1.047	1.451	1.438	1.426	1.277	34	51.948	+ 5.626
Southend-on-Sea Corporation	713	697	616	579	607	561	576	545	34	29.657	- 7.773
South Metropolitan Tramways	*	...	...	...	...	...	...	...	—	—	—
South Shields Corporation	748	671	634	645	751	735	700	702	34½	27.811	+ 1.102
Sunderland Corporation	1.342	1.270	1.317	1.342	1.469	1.424	1.379	1.380	35	52.253	+ 247
Sunderland District	518	529	452	535	544	535	510	553	4	2.143	+ 108
Swindon Corporation	184	172	158	148	179	170	173	165	34	6 821	+ 641
Torquay Tramways	385	404	376	330	410	394	389	361	47	25.969	- 452
Tramways (M.E.T.) Omnibus Co.	*	...	...	...	...	...	...	...	—	—	—
Tyneside Tramways and Tramroads	550	553	489	486	540	521	495	494	21	13.001	- 532
Wallasey Corporation	1.058	1.067	974	994	1.080	1.123	1.060	1.026	34½	45.181	+ 452
Walsall Corporation	673	643	614	625	762	782	769	730	48	35.333	+ 5.303
Walthamstow U.D. Council	744	705	688	689	703	718	718	699	35	31.893	+ 3.300
Warrington Corporation	454	432	411	394	467	462	466	438	34	15.669	+ 750
West Ham Corporation	2.802	2.834	2.690	2.620	2.761	2.870	2.831	2.778	34	106.803	+ 9.565
Wigan Corporation	1.377	1.363	1.309	1.310	1.509	1.541	1.497	1.346	34	52.656	+ 2.475
Wolverhampton Corporation	1.012	1.011	920	1.016	1.087	1.126	1.041	1.021	35	39.162	+ 1.987
Yorkshire (West Riding)	1.496	1.489	1.278	1.375	1.714	1.502	1.420	1.420	48	75.761	+ 6.167

* TRAFFIC RETURNS SUSPENDED.

Owing to the European war, the Government have taken over the railways of Great Britain as from August 4, 1914, and the issue of traffic returns has been suspended. Consequently the traffic returns of the electric railways which usually appear on this page cannot be given.

The Publication of the Traffic Returns of the Tramways marked with an asterisk in the above table have also been suspended during the war.

TRAMWAY DIRECTORIES.

A useful feature of this issue is the directory of electric railways and electric tramways which will be found among the advertising pages. This directory contains the names of the chief officals and the principal particulars relating to each undertaking.

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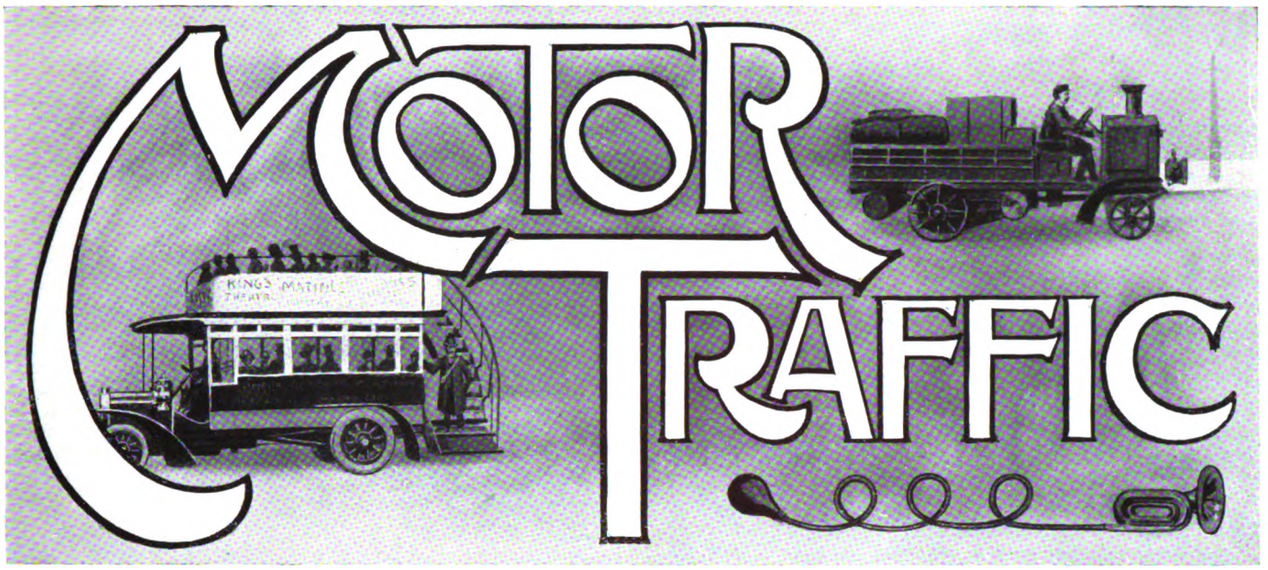

It is to be hoped that the Departmental Committee on Locomotives and Heavy Motor Cars, who have recently taken a great deal of evidence, will not be unduly influenced by local agitations, and will in their recommendations realise that much of the trouble of which local authorities complain has been brought about, not by the legal use of heavy motor vehicles, but by a failure in many quarters to enforce the provisions of the existing Heavy Motor Car Order. Speaking generally, it is desirable that the spirit rather than the letter of an Order of this kind should be obeyed. Nevertheless, such an order provides certain legal machinery that can be set in motion when occasion demands, and the failure on the part of local authorities to utilise this machinery does not justify the creation of new and more restrictive measures. Viewing legislation of this kind as an attempt to prevent undue damage of roads, one of the principal difficulties in practice is connected with the impossibility of differentiating between the use of individual vehicles and the regular employment of large fleets running over prescribed routes. It is almost certain that the damage done by the continual passage of vehicles of one type and of common speed capabilities, is considerably greater than that which would be caused by the passage of an equal number of miscellaneous machines of the same aggregate weight. This fact, if fact it be, and we feel convinced that it is so—must be connected with periodicity. If slight wave formations come into existence over a short length of road surface, the passage of a vehicle similar to that which brought about the first formation must tend to accentuate it, and gradually to extend the series of waves until it becomes a feature of the whole length of road. If, on the other hand, any one type of vehicle only represents a small percentage of the total motor traffic upon the road, no such tendency should be noticeable. In fact, one heavy vehicle might well act more or less in the capacity of a roller removing the depressions formed by those that have gone before it. The point of this argument as applied to a consideration of forthcoming legislation is that it emphasises the contention that such enactments should not be based on individual instances of road damage when the circumstances surrounding the examples chosen are exceptional, inasmuch as they do not represent the general employment of the roads by mixed traffic.

* * * * * *

A point in connection with which many of those who have the ultimate welfare of the motor industry at heart are fully prepared to give ground, is the relation of wheel diameter and tire width to load carried. Legislation encouraging the use of larger wheels and adequate tires would meet with very little real opposition, except in a few very interested quarters. Consequently, no one would be surprised to find the unit of axle weight reduced to $6\frac{1}{2}$ instead of $7\frac{1}{2}$ cwt. for a wheel diameter of 3 ft. As regards tire widths, experience shows that there is a practical maximum limit, beyond which there is no point in going. A very wide flat metal tire cannot be in contact with a cambered road over the whole of its width. A solid rubber tire probably gives something like ten times the area of contact with the road surface as compared with a steel tire of the same width. Consequently, when rubber tires are used, no special legislation is in any way necessary. The minimum dimensions of the rubber tire are limited automatically by considerations of economy in tire maintenance. When dimensions are reduced to a minimum, the area of contact is still considerably greater than that given by a steel tire of the maximum width that can be fitted without going to absurd extremes and converting every motor vehicle into a road roller.

* * * * * *

A sphere in which heavy motor users can reasonably expect some consideration in return for concessions in other quarters is in respect of the use of trailers. At present, the steam tractor running under the Heavy Motor Car Order is only permitted to draw one trailer, the axle weight of any trailer axle being limited to four tons. In special cases where the owners can effect considerable economies by drawing two trailers, a not uncommon practice is to licence the engine under the Heavy Motor Car Order, and also locally as a road locomotive. In the latter capacity, the speed limit is reduced, but two or more trailers may be hauled. In some quarters objections are raised to this practice on the grounds that it is followed with a view to evading the law. In point of fact, any evasions are of a technical and quite unimportant character, and are merely incidental as opposed to intentional. The object of double registration is that mentioned above, and given proper regulations as to trailer tire widths and wheel diameters, there seems to be no conceivable reason why a tractor should not be permitted to run at five miles an hour with two trailers instead of one. If both tractor and trailer were rubber-tired, it should be permissible to draw at least one trailer at a speed of not less than eight miles an hour. Whether it would be safe to draw more than one trailer at this speed is more open to

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MOTOR TRAFFIC.

question. The use of rubber tires on tractors and trailers would of course involve a considerable expenditure on tire maintenance, and on this score it may seem at first sight to be uneconomical. This conclusion would probably be correct with the law as it stands, since when a trailer is hauled no advantages as regards speed accrue to the rubber-tired engine. The German Government, as a result of lengthy experiments with military tractors and trailers, not restricted by arbitrary speed limits, have proved conclusively that the increased efficiency following upon the use of rubber tires on tractor and trailer is far more important from the point of view of the practical utility of the combination than is the cost of tire upkeep. The experiments were of course undertaken with an eye to the military use of the machines, and in this connection efficiency is everything, and economy a minor consideration. However, the reduction of the necessary tractive effort following upon the fitting of rubber tires was so considerable as to make it clear that their adoption on engines in commercial service would be a perfectly sound policy, assuming always that proper consideration is accorded to them in the provisions laying down legally permissible speeds.

* * * * * *

During recent years there has been a tendency to fit rubber tires first to the 3-ton type of steam lorry and more recently to the 5-ton type. So far as it is possible to establish tendencies at a time when business is altogether abnormal, particulars of recent orders placed with important manufacturers of steam motors show that the rubber tire on all sizes of steam lorries continues to gain increased popularity. This should fall in well with the views and desires of those responsible for road maintenance. The solid rubber tire thus bids fair for every reason to become universal upon heavy motor cars. In any new Order this new fact should be taken into account, and if, as is to be expected, the desire of those charged with road maintenance is to encourage the use of rubber tires, or, in other words, to prohibit the use of steel tires, there are only two possible courses of action. One is grossly restrictive legislation, the other lies in the granting of reasonable facilities as an inducement to assist development in the desired direction.

* * * * * *

Already there are indications of the wisdom of the prediction made by Mr. J. B. Hamilton at this year's conference of cleansing superintendents to the effect that the battery vehicle will become the ideal one for municipal work. Effect has also been given to his suggestion that towns not possessing an electricity undertaking can produce power for charging batteries from a dust destructor. A remarkable feature of the Blackpool instance in which advantage has been taken of this alternative, is that the municipality possesses a power station. Doubtless the borough engineer, who is responsible for street watering, will derive an advantage in having the control of the recharging of the battery of his electric water van under his own supervision, and his enterprise will add further data, under more advantageous circumstances, as regards the quality of the fuel, to the information already compiled as to the cost of generating power by means of dust destructors. Probably the borough engineer also entertains hopes of being able, by reason of the low cost of his fuel, to produce power at a cheaper rate than it can be supplied by the electricity department. Important and extensive as is the work of street watering at Blackpool, the laying down of generating plant at the dust destructor, when a power station is already available, might be regarded as too expensive a proceeding if the electricity were to be used only for propelling a single vehicle. True it is that in this case the van is also used for washing the esplanade tramway track and the promenade at night, but there are many days during the colder part of the year when street watering is not necessary. Scope exists, however, at this time of scarcity and costliness of horses, for using battery vehicles in the collection of the house refuse that supplies the destructor with fuel, as well as for general haulage work. Doubtless in the carrying out of those tasks the chassis of the watering van could be utilised. Of the ultimate success of the Blackpool department there can be no question, and it will help to bring battery vehicles into use in many places where otherwise their introduction would be impossible. This course should be particularly easy of adoption in towns where the working of a destructor has been adapted, either wholly or partly, to the production of power for lighting, a proceeding of great importance in this time of high prices for steam-raising coal.

ELECTRIC VEHICLES.

New Rates for Battery Charging.

At the instance of Mr. R. A. Chattock, their electrical engineer, the Birmingham Electricity Committee have amended their rates for charging the batteries of electrical vehicles. Hitherto the minimum rate was 2s. for 24 units, but if only 12 units were taken there was no reduction in the amount paid. It was found by a number of traders who are using ½-ton vehicles that the normal weekly consumption for about 200 miles is 96 units, which would cost 8s. at the rate of 1d. per unit, which is charged for 12 units. The minimum charge has now been reduced to 6s. per week, and to 1s. for any boosting required at any period in the day, any excess of power taken to be charged at the rate of 1d. per unit.

Sales of Commercial Vehicles.

Mr. B. M. Drake, who presided at the annual meeting of Drake and Gorham, stated that the use of commercial lorries and delivery vans propelled by electric accumulators had been extended during the year, and vehicles had been supplied to the Liverpool Corporation, the Corporation of Bury, Messrs. Sir W. G. Armstrong, Whitworth and Company, Limited, Messrs. Greenall, Whitley and Company, and the Blackpool Industrial Co-operative Society, with repeat order. Subject to the acceptance of deferred payment, they had the offer of several Corporation orders.

THE COLLAPSIBLE HOOD FOR OMNIBUSES.

Managers of motor-omnibus undertakings who have made inquiries concerning the Beck collapsible hood (illustrated in The Tramway and Railway World of September 9) will be interested to learn that several improvements in details will be made when the appliance is placed on the market. A second demonstration of its capabilities was given in London on November 16 by Mr. F. H. Beck, of Willesden Paper and Canvas Works, Limited, the patentee. Representatives were present from the London General Omnibus Company, National Steam Car Company, British Electrical Federation, the London and North-Western Railway, etc. The hood was fitted to an Allen omnibus, and undoubtedly it answers the purpose of keeping dry the passengers on the top deck, but the present design does not ensure a complete absence of draught. Means have been devised, however, to remove an objection to which we drew attention some time ago, viz., the obscuring, when the hood is folded, of the lower portion of the front destination board, if the whole depth of the top deck railings is used either for that purpose or as an advertising medium. When the hood is raised there is a height of 6 ft. covered in, and the total height of the vehicle is 14 ft. 6 in., thus permitting it to pass under most bridges. For ease of manipulation the hood outstrips the appliance used on chars-a-bancs. It can be raised or lowered in thirty seconds, and as the Willesden canvas of which it is constructed is waterproof, it can be folded wet without damage.

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MOTOR TRAFFIC.

FROM SALISBURY TO CAPE TOWN.

A Journey made by Mr. C. A. Henderson.

We received on November 8 the subjoined account of one of the most remarkable runs ever accomplished in a motor car. It was undertaken and carried through by Mr. A. C. Henderson, of Mazoe, Rhodesia, accompanied by his friend, Mr. R. B. Mitchell, a well-known member of the Scottish community of Salisbury.

The travellers left Salisbury on September 1, and broke all records by getting through to Cape Town on Friday, September 24. The distance covered was 1,953 miles, and no car has previously been able to complete the journey. A great part of the way was entirely trackless, and at such points the help of native guides had to be obtained, or the car steered as near as possible by the compass. It can be imagined that many exciting moments were experienced by the intrepid driver and passenger, and it is nothing short of marvellous that a car has at last succeeded in doing this journey.

Mr. Henderson imported the car—an extra strong Colonial Napier—nearly three years ago, and it was not tuned up in any way for the arduous journey, the whole trip being hurriedly arranged. The run occasioned great interest in South Africa, and the betting at the principal clubs was 3–1 on reaching the Limpopo River, 5–1 on reaching Johannesburg, and 10–1 against the trip being completed at Cape Town.

Mr. Henderson writes:—The idea of this trip, which has now been successfully completed in 23 days (eight of which were spent in Johannesburg) originated in a semi-serious suggestion of mine in my club at Salisbury. It was enthusiastically seconded by my fellow traveller-to-be, Mr. R. B. Mitchell, and accordingly we decided to leave in two days and endeavour to accomplish this record run.

Napier Car on Barkly West Bridge, Transvaal.

Naturally, beyond renewing the tire covers and general oiling up, there was no time to do anything else to the car, which left for the trip practically untouched, and having already over 10,000 miles to its credit over the roughest roads in Rhodesia, the betting was at long odds against the successful completion of the contemplated trip.

The start was made from Salisbury at 3 p.m. on September 1, but the last good-byes were said at Beatreace, to which point the Napier was accompanied by a party of motorists. From here the road to Enkeldoorn furnished next morning a foretaste of much that was undesirable to follow. Heavy sand necessitated a lot of second gear travelling, but such good time was made that a car which started two days earlier reached Enkeldoorn only as many hours ahead. To Umvuma, where the second night was spent, an average of 10 miles per hour only was maintained, but in the morning this was increased to 18 miles per hour on the fairly good road from there to Gwelo. The day's run finished at Shangani, which was reached at 5.30 p.m. At 1 p.m. on the fourth the Napier was at Filibusi, and at Balaballa in another hour. The fourth night was spent on the veldt, and in the morning a native was requisitioned as guide, there being no defined road at Gwanda. Balaballa to Gwanda (45 miles) was covered at an average of 7½ miles per hour. West Nicholson was the next stop, and here the fifth night was spent.

Musunga, the homestead of the Liebig estate, was reached in five hours next morning at an average of 12 miles per hour; and at 7 o'clock (from 3.30) the same evening the Limpopo River 40 miles ahead. Next morning, with the assistance of a team of donkeys, the river was crossed three miles lower down. The afternoon was spent at Messina in oiling the car. Leaving Messina at 6 a.m., six hours were occupied in reaching Louis Trichardt, 60 miles distant, the Sand River proving a serious obstacle; but from here to

Napier Ascending the Southern Bank, Limpopo River.

Pietersburg 24 miles per hour was averaged over the best bit of road found on the trip. The night was spent at Potgietersrust, reached in 3½ hours from Pietersburg. The eighth day out started at 6 a.m., and at 1 p.m. the Napier was in Pretoria (141 miles), and the 36 miles to Johannesburg took another 90 minutes. The total distance covered in the eight days was 853 miles, and with the exception of a broken fan belt no mechanical trouble had been experienced.

Eight days were spent in Johannesburg, and a start again made on Friday afternoon, the 17th. The night was spent at Potchefstroom. Next day the 122 miles to Bloemhof took six hours. Just over 14 miles per hour was averaged to Fourteen Streams, where the night was spent at the railway station. From 7.30 a.m. Kimberley (69 miles) was reached in 4½ hours via Barkly West, and in the afternoon the journey was continued to Belmont (60 miles) at 20 miles per hour. The 28 miles to Hopetown took two hours next morning, and, starting again at 10, Britstown (90 miles) was reached at 3.

Napier Crossing Dry Bed of River Insiza.

At Victoria West the night was spent on the veldt, and at 11 a.m. the Napier was at Beaufort West, the running time for the 88 miles

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MOTOR TRAFFIC.

being six hours. Leaving here the road to Fraserburg was taken in mistake for Fraserburg Road, and Sutherland was not reached till 4.30, the running time for the 153 miles being eight hours. The night was spent at Matjesfontein, which was reached at 11.30, two hours having been spent on the road in resting and tire repairs. Wellington was the last night's stop, and Cape Town was reached in two hours on the morning of the 24th.

I drove throughout the trip, the running time for the total distance covered (1,953 miles) being 126 hours. The running time from Johannesburg to Cape Town was 61 hours, beating all previous records by six hours. Petrol consumption averaged 18 miles per gallon, the total quantity used being 108 gallons.

Both the car and ourselves came well through the strenuous journey; we felt none the worse. The Dunlops on the rear wheels were in excellent condition. We have to acknowledge many courtesies and kindnesses received en route, and desire to convey our thanks to the following:—Messrs. Webb (Beatreace), Williams and Pinches (Gwelo), Stewart (Shangani), McKenzie (Liebig's), Emery (Messina), Israel (Halfway House, Johannesburg to Potchefstroom), Whyte (Johannesburg), Pope (Holmes Garage, Kimberley), Harris (Belmont), and Gerald de Wet (Beaufort West); and especially to Mr. Wilkins, of Connack's Garage, Johannesburg, for his generous assistance.

The following is a copy of my log, the times given being an indication of the nature of the road:—

From–to.	Miles.	Running Time. Hours.
Salisbury	— ...	—
Beatreace	36 ...	2
Enkeldoorn	58 ...	5
Umvuma	32 ...	3
Gwelo	55 ...	3
Shangani	44 ...	3
Filibusi	76 ...	5½
Balaballa	18 ...	1
Gwanda	45 ...	6
West Nicholson	28 ...	3
Musunga	60 ...	5
Limpopo River	40 ...	3½
Messina	16 ...	4½
Louis Trichardt	60 ...	6
Pietersburg	70 ...	3
Potgietersrust	38 ...	3½
Pretoria	141 ...	7
Johannesburg	36 ...	1½
Potchefstroom	74 ...	3½
Bloemhof	122 ...	6
Fourteen Streams	58 ...	4
Kimberley	69 ...	4½
Belmont	60 ...	3
Hopetown	28 ...	2
Britstown	90 ...	5
Victoria West	88 ...	6
Beaufort West	92 ...	4
Fraserburg	83 ...	4½
Sutherland	70 ...	3½
Matjesfontein	75 ...	4
Worcester	86 ...	5
Wellington	39 ...	2
Cape Town	45 ...	2

SKIDDING HELD TO BE NOT NEGLIGENCE.

The London County Council sued Bishop and Sons, of Pimlico, at Woolwich County Court, on November 17, for £3 15s. damage caused to two tramcars through the alleged negligence of defendants and their servants. While defendants' motor lorry and trailer were going down Albion Hill, Woolwich, they skidded and were run into by a tramcar going up the hill. The motorman received fatal injuries, and his car ran back and collided with another car. To a constable the driver of the lorry stated that he was going at four miles an hour. It was stated by Mr. G. R. Knight, of the Council's Tramway Department, that the lorry was fitted with rubber tires on the front wheels and iron tires on the rear wheels. In his opinion a sudden application of the brake would make the lorry liable to skid. In cross-examination witness said he did not allege negligence in sending out a vehicle fitted with the tires mentioned. He added that the driver might have to use a little more care. Evidence was given by Mr. Alexander, motor engineer, that the general experience of users was that it was bad practice to use iron tires on the rear wheels and rubber on the front, especially in London. To prevent skidding it had been proved to be best to have rubber tires on both sets of wheels. The iron wheels were straked for the purpose of gripping the road surface going up a hill, and not as a non-skidding device. Cross-examined, witness agreed that over and above a certain weight the authorities insisted upon iron wheels being straked diagonally, but all his experience showed that it was for gripping purposes only. His Honour, Judge Granger, ruled that no negligence had been made out. The courts had held that skidding was not sufficient to establish negligence, and he gave judgment for defendants with costs.

STRAKER-SQUIRE IN WAR SERVICE.

The accompanying illustration of a Straker-Squire covered van "somewhere in France" gives an excellent idea of the popularity of the British soldier with the French people. The photograph shows a party of our men being conveyed in a Straker 4-ton van, which had been requisitioned by the military authorities at the beginning

Straker-Squire Van as a Transport Vehicle.

of the war from Maple & Co. Ltd. While the women folk are waving their hands the men are throwing "smokes," fruit, etc. to their British comrades.

Prior to its service as a military transport vehicle, the machine was in regular nightly service between London and Birmingham for about six months. It was a recent acquisition from Straker-Squire, Ltd., of Blackfriars, S.E., Twickenham, and Bristol.

MOTOR VEHICLES FOR MUNICIPALITIES.

Aberdeen Council have agreed to purchase a Laffly motor street sweeper at £650.

Chesterfield Council are considering the provision of a motor wagon for the removal of refuse.

Loftus Council have the advisability of purchasing a motor fire engine under consideration.

Gerrard's Cross Fire Brigade are being provided with a motor fire engine by public subscription.

Hackney Council have referred back to the Highways Committee a recommendation for the purchase of horses instead of a motor vehicle.

Leeds Tramways Committee have purchased a Belsize chassis for £680, in order to increase the motor omnibus service on the Shadwell route.

Calcutta Council have decided to substitute motor ambulances for the horse and hand conveyances now in use. As a beginning they have decided to purchase two Star ambulances, which are to be placed under the charge of the Fire Brigade.

Shoreditch Council have agreed to purchase two Laffly motor road sweepers at a cost of £671 each. As compared with the purchase of horses, the surveyor estimates that there will be a saving of £671 in one year.

Lancaster Corporation on November 24 adopted a recommendation by the Tramways Committee to apply for a provisional order to enable the department to run motor omnibuses. The vehicles are required for the conveyance of factory workers.

Sheffield Council have agreed to give a three months' trial to an automatic truck suitable for the collection of road sweepings. It will be supplied by Edison Accumulators, Limited. If purchased the price will be £561 17s., and if returned the cost of hire will be paid.

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MOTOR TRAFFIC.

SHEFFIELD OMNIBUS SERVICE.

Second only in importance to their use with the British Expeditionary Force in France is the provision of motor vehicles for the transport of munition workers in this country. The Government have encouraged the provision of vehicles for this purpose at a time when expenditure on tramway construction is barred. Even if

Daimler Double Deck Sheffield Omnibus.

that were not so, the consideration would still arise whether the more expensive form of traction would be justifiable for traffic that may cease when the war terminates. Sheffield is perhaps the busiest war-work district in the country, and fortunately the tramways committee some years ago had entered upon the policy of extending their tramway routes by means of omnibus services. Thus, at the present time, every main road out of the city but one

Daimler Single Deck Sheffield Omnious.

possesses a means of public conveyance beyond the tramway terminus.

With the vehicles that have recently been delivered for service in districts where munition workers live, the department has now twenty-one motor omnibuses—nine of them are Daimlers with the sleeve-valve engines—the seating capacity being generally 34, while the weight averages about 4½ tons. These vehicles are generally rated as having 40 H.P. engines. The first half-dozen omnibuses have been in service 2½ years, and many of the earlier omnibuses have now run over 75,000 miles.

The department finds that there is work for at least 45 motor omnibuses in this direction, and as soon as the war is completed it is the intention of the Sheffield Tramways Committee to extend their services and to increase the services on the existing routes. The accounts for 1914–15 were set out in detail in the TRAMWAY AND RAILWAY WORLD for October. A summary of the results of the working, compared with the previous twelve months, is given below, and demonstrates the wisdom of the committee in promoting this branch of the service.

	Year ended March 25, 1914.	Year ended March 25, 1915.
Total Receipts	£9,128	£16,116
Total working expenses (including payment of all charges, including departmental, depot, and head office expenses)	£5,974	£10,827
Interest, sinking fund, and depreciation on a five years' basis	£1,883	£2,597
	£7,857	£13,424
Net profit carried to reserve fund	£1,271	£2,692
Receipts per omnibus mile	10·2d.	10·471d.
Working expenses per omnibus mile	6·675d.	7·035d.
Interest, sinking fund, and income tax per omnibus mile	·584d.	·611d.
Depreciation per omnibus mile	1·520d.	1·076d.
	8·779d.	8·722d.
Profit per omnibus mile	1·421d.	1·749d.

ARMY TRANSPORT WORKSHOPS.

TRAMWAY OFFICER'S APPOINTMENT IN FRANCE.

Lieutenant J. Austin Baker, officer in charge of the A.S.C. Workshops, Heavy Armoured Cars, British Expeditionary Force, France, before enlisting in the army was on the traction department staff of the British Westinghouse Company, Limited, Manchester. For some years Mr. Baker was assistant rolling stock superintendent of the West Ham Corporation Tramways, first under Mr. H. E. Blain, and afterwards Mr. J. S. D. Moffet. He enlisted in January last in the Army Service Corps as a lorry driver, and in July was promoted sergeant and transferred to be an assistant foreman fitter in the shops. After giving proof of having served his apprenticeship in the Lancashire and Yorkshire Railway locomotive shops, University technical education, and positions held at home, he was promoted to be workshop officer with a commission as second lieutenant. The test for a commission is by no means a light one, and in the A.S.C. the candidate has to qualify in theory and practice of all types of road and transport systems. Lieutenant Baker is, as far as we know, the only tramway official who is occupying the post of workshop officer in the A.S.C. Mechanical Transport, and one of the few who is in command of a unit.

PARKING ELECTRIC CARS IN CHICAGO.—Through the efforts of the Electric Vehicle Association of America a system of parking electric cars has been instituted in the shopping district of Chicago. As many cities have laws denying the privilege of cars standing stationary without a driver for any length of time, the extension of the parking system is likely to be widespread. In Chicago several garages have been established, under the auspices of the Electric Vehicle Association, a parking service for their customers, enabling them to leave their cars at the electric shop of the Commonwealth Edison Company, where a chauffeur drives it to the park and returns it again whenever ordered. There is no charge for this service. The car owner simply understands that by taking advantage of the service he entirely agrees that the driver is acting only in the capacity of the owner's personal agent. In the autumn a night service will be arranged for theatre patrons.

ELECTRIC CABS FOR NEW YORK.—As the result of trials with a battery-driven cab in New York, a company has been formed with a capital of £200,000 for the purpose of providing the city with a regular service of those vehicles.

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MOTOR TRAFFIC.

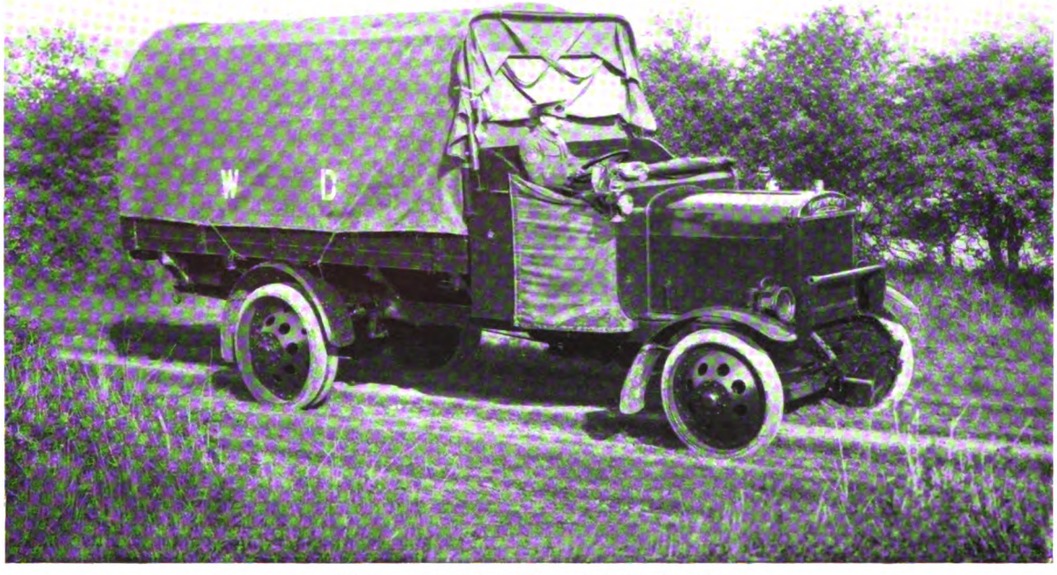
THE THORNYCROFT LORRY.

The British commercial motor industry is indebted to John I. Thornycroft and Company, Limited, for the steps they have taken to show the world something of the work that our motor vehicle manufacturers are doing for our million-strong army in France and Belgium. No better testimonial to the reliability of the British-built conveyance can be desired than the record of its work under the trying conditions of this war. That record is set forth in a 16-page booklet issued from the company's head office at Caxton House, Westminster, S.W., and it is illustrated by two dozen photographs.

Letterpress and illustrations not only deal with the part that mechanical traction is playing in the present war, but go back to the pioneer work that Thornycrofts performed for the military transport service as long ago as 1899. In that year they supplied a steam wagon to the Royal Engineers as an experiment. An order was received for ten vehicles, and at the end of 1901 the company took the first prize among the eleven firms who had entered lorries for the War Office trials, the Foden Company's exhibit being placed second. Both of these steam types rendered great service during the South African war and at army manœuvres up to 1904, when the War Office called for a 5-ton lorry driven by an internal combustion engine, using petroleum as fuel. This produced the Thornycroft paraffin lorry.

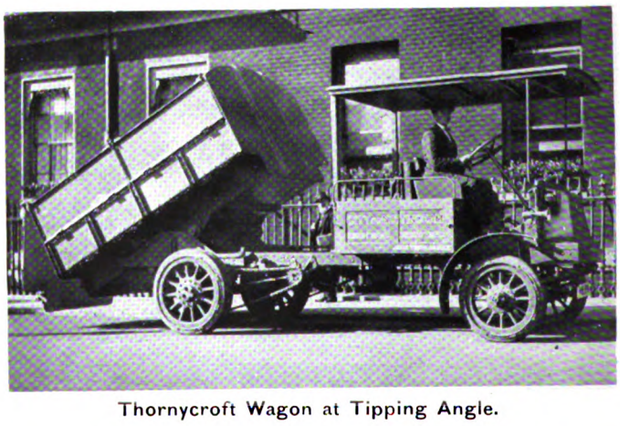
In 1907 the Royal Automobile Club held the thousand miles' trial for commercial vehicles, the War Office offering special certificates for vehicles running on petroleum. Both of the Thornycroft vehicles went through the run without loss of marks, gaining for their makers the certificates and an order for two lorries to be supplied to the War Office. In 1909 came the War Department trials for tractors, when the Thornycroft machine secured the only prize (£750).

In 1913 the War Office subsidy scheme was inaugurated for petrol lorries. Thornycroft's were one of the first two firms to enter vehicles for the first trial under the scheme, and their 4-cylinder 30 H.P. type gained the certificate, and was speedily placed in service by Pickford's Limited. Since then the machine has developed into a chassis having an engine with four cylinders cast in pairs, developing 40 H.P., and carrying 4½ tons. It is illustrated on this page, and is known as the "J" type. Large numbers of them have been supplied to the War Office every week since the outbreak of the war. The "J" machine has four speeds and reverse, the speeds ranging from 2¼ miles on the reverse to 14½ miles on the fourth speed. The chassis can be adapted to run on kerosene, thus ensuring a large saving in the cost of fuel.



Thornycroft War Office Subsidy Lorry.

Thornycroft Tipping Wagon.



Thornycroft Wagon at Tipping Angle.

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MOTOR TRAFFIC.

CONVEYANCE OF FACTORY WORKERS.

The illustration given on this page shows one use to which the 32 H.P. 3-ton vehicles constructed by the Albion Motor Car Company, Limited, are being put.

3-ton Albion Lorries.

Forty-six of these machines have been obtained from the Glasgow company by Messrs. Vickers, Limited, engineers, shipbuilders, etc., at Barrow and London. Fourteen of them are used for the conveyance of material, and the remaining thirty-two, fitted with collapsible hoods, and also with seats, are utilised for the conveyance of the firm's workpeople to and from their various factories

UTILITY OF THE COLONIAL NAPIER.

A Large Order for War Service.

A fleet of Napier ammunition wagons, a part of a large batch to be delivered to the Government, is illustrated in the photograph below. The chassis in every case is the well-known 20 H.P. extra strong Colonial Napier, which on ambulance and staff car duty has earned a big reputation on the various allied fronts.

The special duty of these vehicles is to carry ammunition as near as possible to the firing line. It will be agreed that this is a very arduous task, and for such service only cars of the utmost reliability could be chosen.

The characteristics of the Napier vehicle are (1) the extreme silence of the engine ; (2) the easy springing, which is of the cantilever type ; and (3) the dependability which this Napier model has earned for itself throughout the world.

ELECTRIC VEHICLES AND PUBLIC HEALTH.

Mr. F. Ayton, tramways manager and electrical engineer to Ipswich Corporation, and hon. secretary of the Electric Vehicle Committee, has issued a circular letter in which he calls attention to a report (recently published in The Tramway and Railway World) that Manchester Corporation have served notices upon a large number of owners and tenants to abate an alleged nuisance by discontinuing to keep horses on their premises. Copies of the letter have been forwarded to municipal, police, fire brigade, tramway, gas, water, and central station engineers throughout the country. Mr. Ayton surmises that the action of Manchester is likely to be followed elsewhere, and remarks that if horses are to be displaced in this way motor traction in some form will have to be adopted. He adds :—" The electric battery vehicle is in every way an ideal vehicle for town use. It is odourless, silent, and by far the cheapest to run. It also causes considerably less road wear than the petrol vehicle. My committee therefore suggest that municipalities should make special efforts to encourage the use of the electric battery vehicle in the areas under their control. The most convincing way of doing this is to set the example by using such vehicles for municipal work, such as watering roadways, scavenging, house refuse removal, cartage of road and other materials, ambulance work, fire brigade work, cartage of coal and ashes, as well as for passenger transportation by means of electric battery omnibuses. Smaller electric vehicles can also be used to advantage for the transportation of officials in performance of their duties. Not only will the adoption and use of electric vehicles in these directions gradually have the effect of doing away with stables, but it will, in addition, bring a handsome revenue to the electric supply undertaking. My committee have every confidence in asking you to give them your careful consideration, and to examine for yourself the examples of electric vehicles that are daily becoming more numerous in this country."

Colonial Napiers as Ammunition Wagons.

Bombay Motor Postal Service.—The horse wagon service of Bombay Post Office was superseded on October 1 by twelve motor cars, run by the Mahableshwar Motor Service, under the direction of Mr. Brearley.

The Institution of Automobile Engineers.—The next meeting will be held on Wednesday, December 15 (not December 8 as previously announced), in the hall of the Surveyors' Institution, 12, Great George Street, Westminster, S.W., at 8.0 p.m., when Mr F. W. Lanchester will read a paper entitled " The Cylinder Cooling of Internal Combustion Engines, More Especially as Concerning Automobile Practice." Cards of invitation may be obtained on application to the Secretary of the Institution of Automobile Engineers, 28, Victoria Street, S.W.

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MOTOR TRAFFIC.

IN THE LORD MAYOR'S SHOW.

Some idea of the varied nature of the work that has been accomplished in the national interests during the past year by Tilling-Stevens, Limited, is given in the subjoined photograph of a Tilling-Stevens petrol electric lorry. It is of the 4-ton type, and upon it is mounted a searchlight. These products of the Victoria Works, Maidstone, were supplied to the Admiralty, and were introduced into the Lord Mayor's Show as part of the Royal Naval unit that undertakes the defence of the capital against air craft.

Tilling-Stevens Lorry with Searchlight.

LIGHTING OF MOTOR VEHICLES.

C. A. Vandervell and Company have issued a 64-page booklet dealing with electrical illumination for public service and commercial motor vehicles. The publication ranks as an art production, and is a fitting sequel to the success that the company has attained in electric lighting of motor vehicles, as the result of many years research and experiment. During the past five years 15,000 commercial and public service vehicles have been fitted with their dynamos, batteries, etc., and their Acton works alone are capable of installing 95 cars per week, while the Birmingham and Manchester establishments possess considerable facilities for effecting speedy equipment. In referring nearly two years ago to the company's work on some of the motor omnibuses running in the London suburbs we remarked that the brilliancy of the electric lighting till twelve o'clock at night was equal to the presence of extra police on many a mile of lonely road. Now that the war has brought about a reduction of light, it is worthy of note that the restriction has been effected on the same vehicles without any of the heavy and destructive painting of the incandescent lamps that has to be undertaken in tramcars. If any further reduction becomes necessary in these omnibuses it can be made by means of shades.

MOTOR TRAFFIC NOTES.

Petrol Tramcars in Australia.—Authority has been granted to the Beaumaris Tramways Company, Victoria, to use either petrol or electric cars.

Electric Vehicle Committee.—Sheffield Electric Supply Committee have contributed three guineas towards the expenses of the Electric Vehicle Committee of the Municipal Electrical Association.

The Anzac Motor Company, Limited.—The business conducted by Mr. W. Turner Smith, sole concessionaire for the G.M.C. trucks, Oakland, and Olds mobile cars, as from December 1 will be carried on under the title of the Anzac Motor Company, Limited, who have taken over all liabilities and assets. The business will be carried on at the same address as formerly, viz., 78 to 82, Brompton Road, London, S.W., under the direction of Mr. Turner Smith as managing director of the company.

Revenue and Expenditure of the Road Board.—Replying to a question of Sir John Spear in the House of Commons, Mr. Montague, secretary to the Treasury, stated that the total receipts of the Road Board up to September last, including interest on investments, amounted to £7,176,059. The total grants actually made to highway authorities up to the end of October amounted to £2,410,978. The advances made by way of loan aggregated £932,259. The balance in the hands of the Board on September 30 amounted to £3,966,065, including £3,924,742 investments at cost.

Tire Bonus Scheme.—Users of solid rubber tires will be interested in a scheme devised by Wood-Milne, Limited, Preston, as an incentive to careful driving and to economy. On January 1, 1916, the company will inaugurate a drivers' bonus payment, under which a sum of 5s. per tire will be given on all Wood-Milne solid tires that complete the guaranteed 10,000 miles on and after the date already mentioned. The company will only pay the bonus through the employer, who must notify them when the distance has been completed. Mileage books, etc., will be supplied free on application to the company.

Future Street Traction.—The question whether electric tramways will give place to motor omnibuses was raised at a meeting of the Junior Institution of Engineers at Manchester on November 15. Mr. E. D. Phillips, in taking the affirmative view, said there was already ample evidence to that effect, and he contended that the scrapping of tramways was only prevented by the strength of their immense capital interests. Mr. Phillips's contention was not upheld by a majority of the members who took part in the discussion, and one speaker expressed the opinion that tramways would develop in the direction of fast running.

Stirling Petrol Tramway Car Experiment.—Mr. H. F. Brand, who presided at the annual meeting of Stirling and Bridge of Allan Tramways Company, on November 8, stated that owing to the difficulty of securing and keeping horses, the directors were anxious to obtain a Provisional Order to allow of the introduction of a system of petrol-propelled cars, but at the request of the local authorities they had temporarily dropped the scheme. The Board of Trade had renewed for another year the provisional licence granted for the experimental running of the petrol car on the St. Ninians route. A dividend at the rate of 4 per cent. was declared.

Motor Services at Barnsley.—A note in our issue of November 18, stating that owners of motor vehicles plying for hire in Barnsley had been invited by the Corporation to submit offers for running a daily service to one or more of the outlying districts, may have misled some of our readers. We are informed that the service of motor vehicles plying for hire from Barnsley to the surrounding towns and villages is on a fairly extensive scale, and at the present time there are about 120 vehicles engaged in these services. The Barnsley and District Electric Traction Company were the first to introduce in Barnsley a motor-omnibus service, and they published a time-table covering over 50 miles of route. Competitors subsequently introduced other services, and now run over 100 vehicles. These vary from large chars-a-bancs to little Ford omnibuses seating eight persons, the majority of which are running on "jitney" lines somewhat similar to the pirate omnibuses which were familiar some years ago in London. On July 1 last the Corporation issued regulations for the control of these public vehicles owing to the congestion on the central stand. These regulations reserved the central stand to vehicles which ran to published time-tables, and allotted various other stands for vehicles running indiscriminately. These regulations worked satisfactorily for a time until a number of the "jitney" vehicles commenced to invade the central stand every day, with the object of snatching up any passengers who might be waiting, thereby setting at defiance the regulations of the Corporation. So far the local authorities have not taken any further action in the matter, which seems to call for early consideration.

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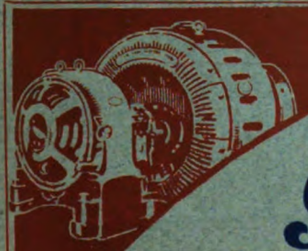

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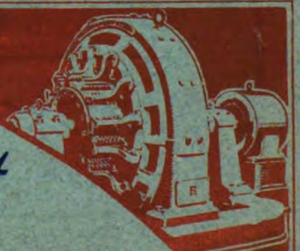

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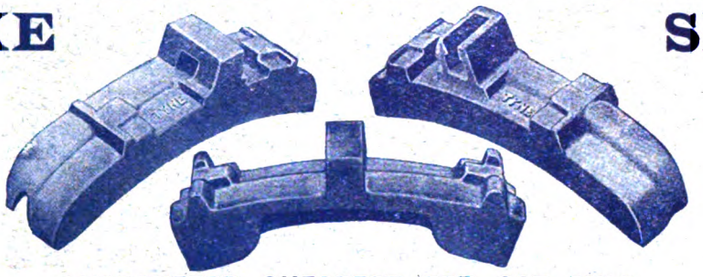

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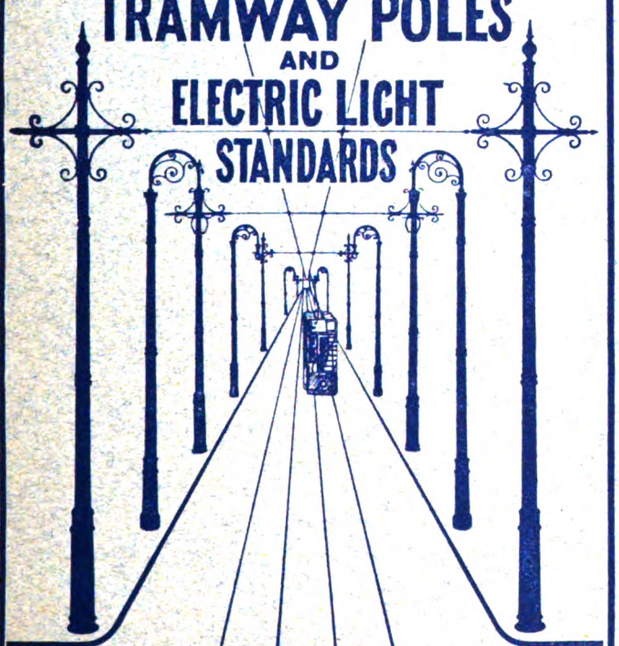

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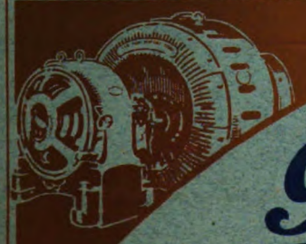

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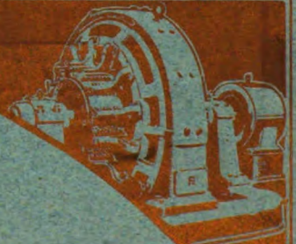

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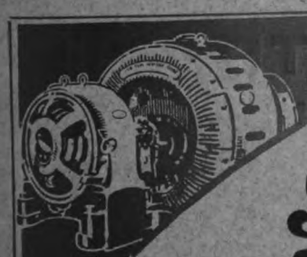

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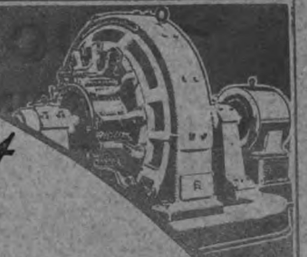

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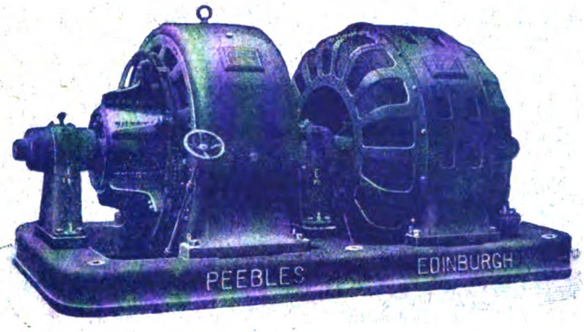

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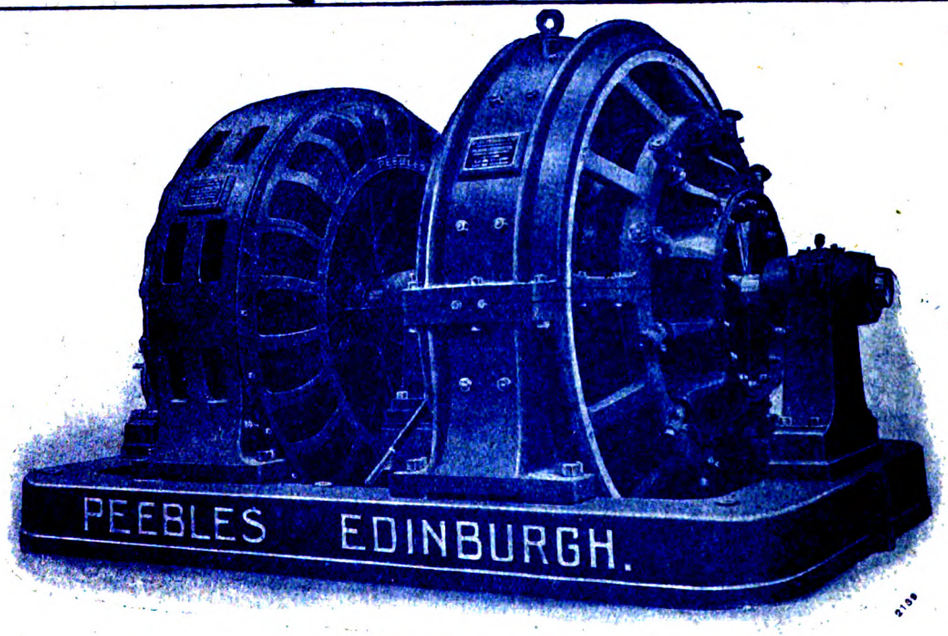

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DECEMBER 9, 1915
Vol. XXXVIII., No. 29.
WITH
"MOTOR TRAFFIC" SECTION

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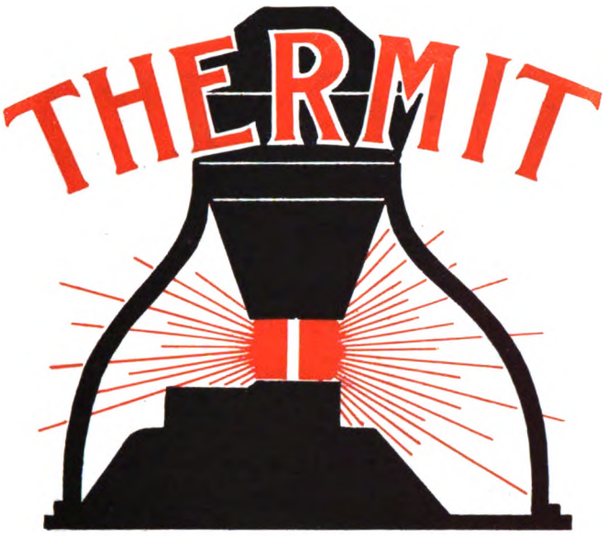

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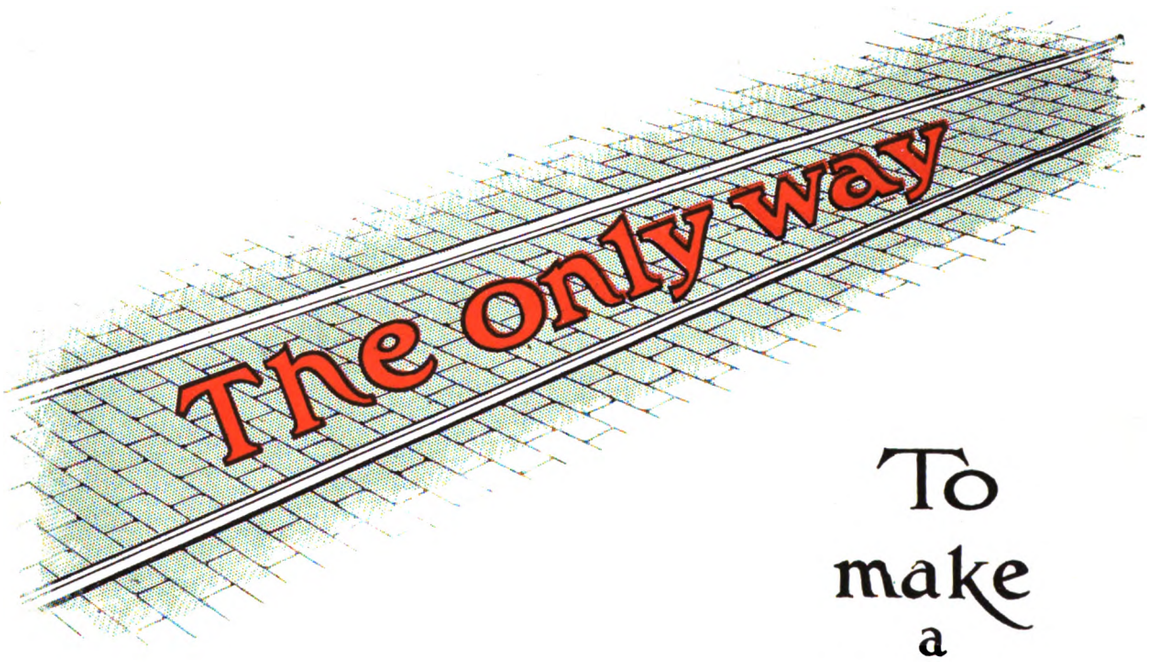

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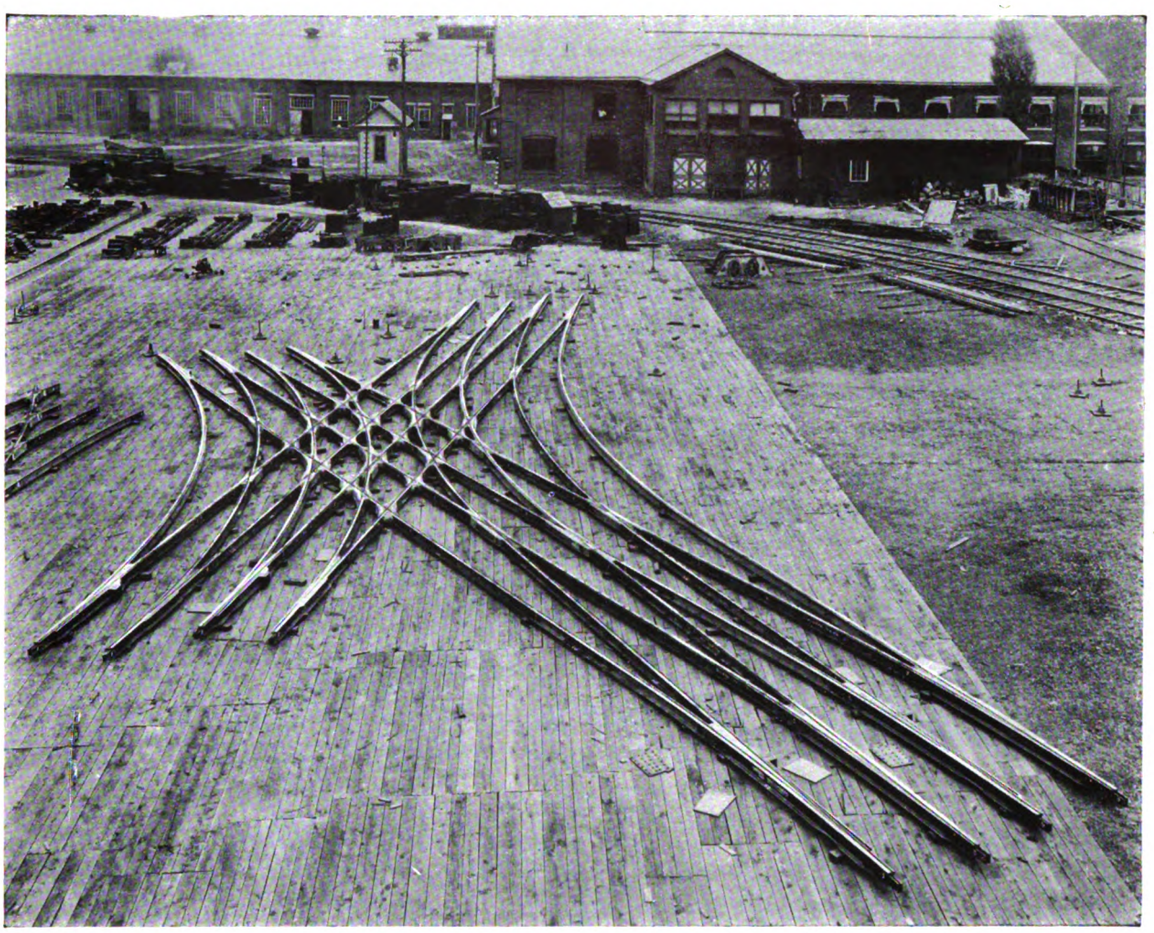

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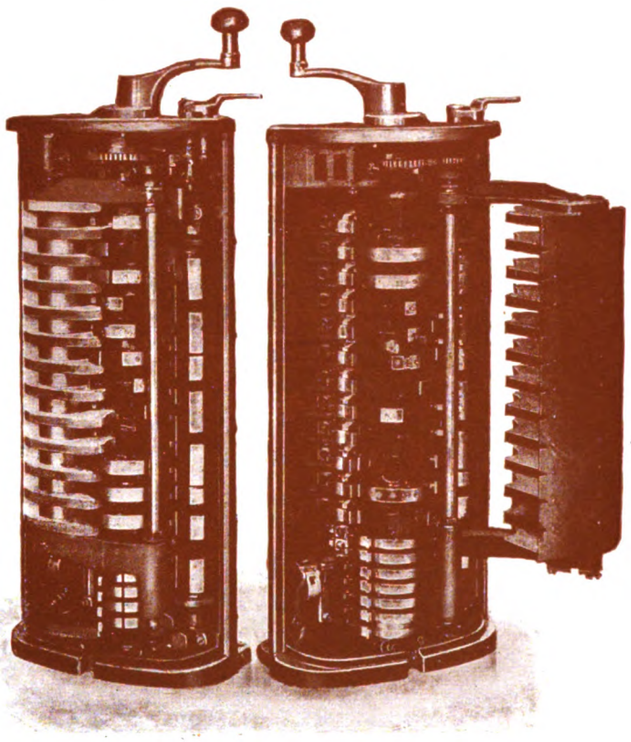

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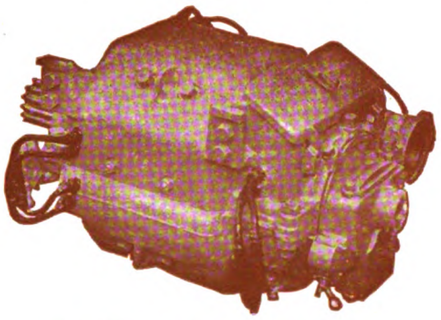
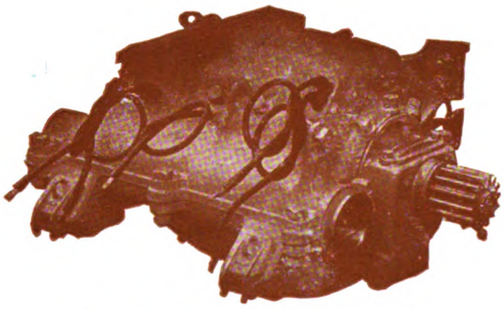


D.K. 20—Light Weight Tramway Motor.
View from commutator end.



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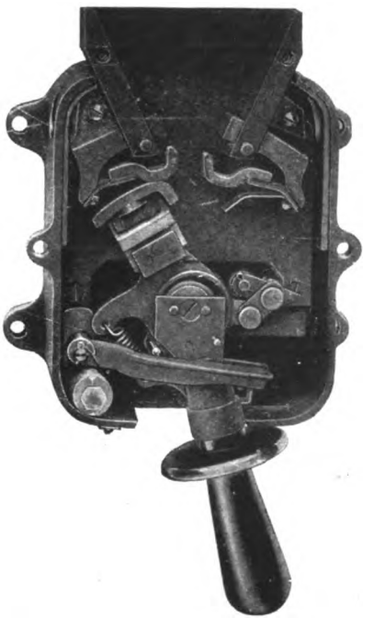

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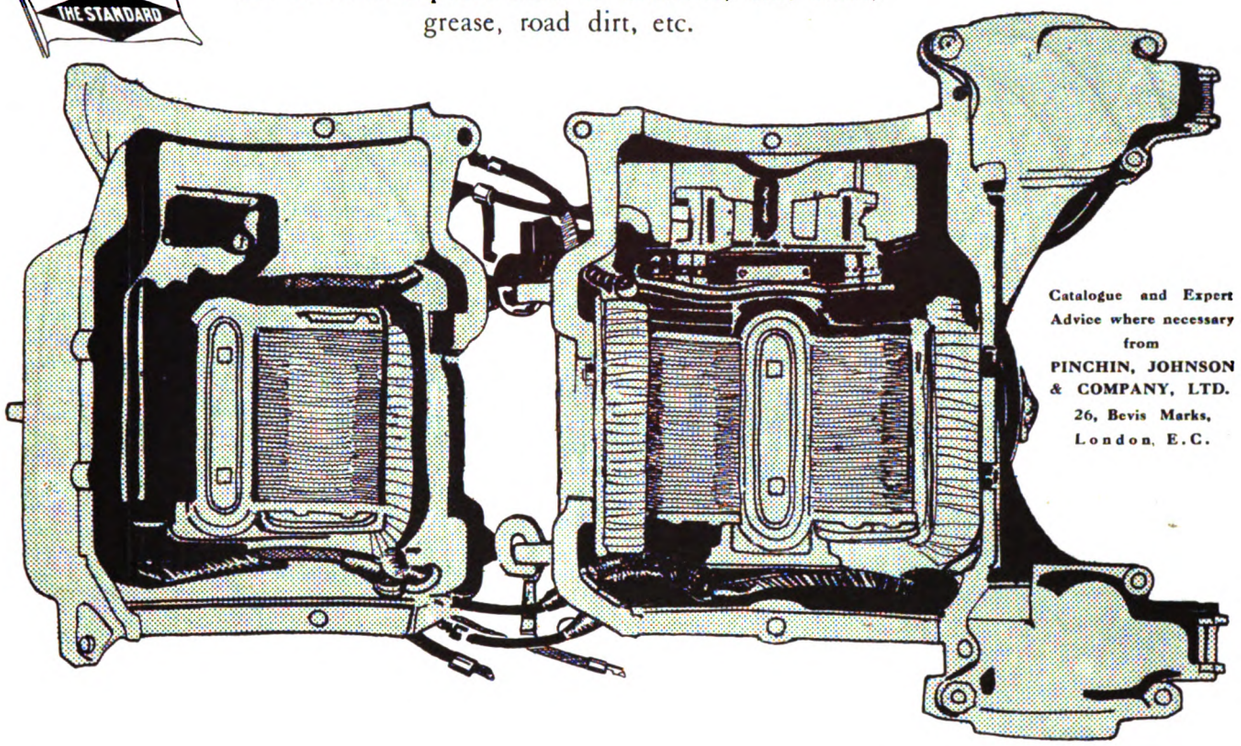

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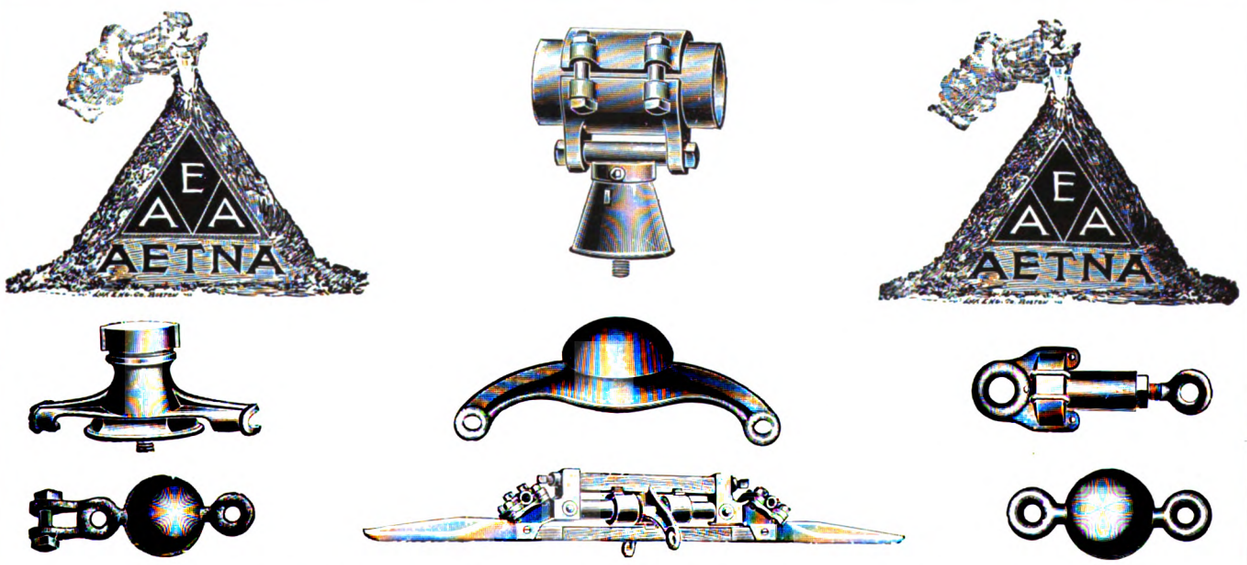

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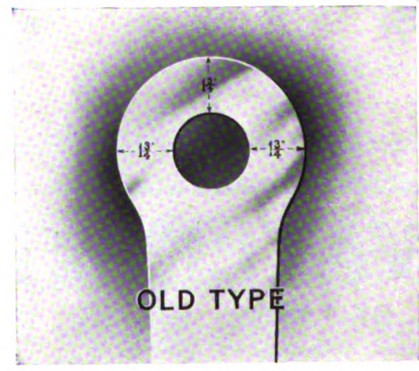

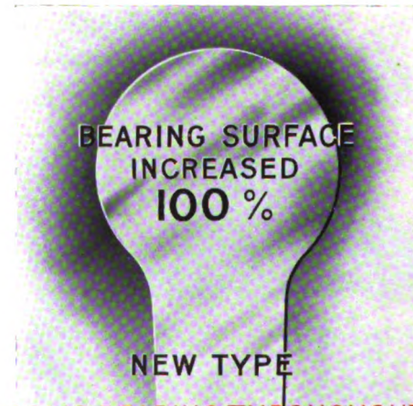

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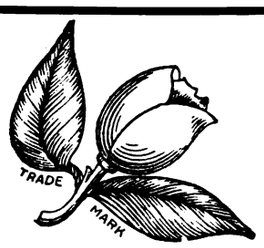

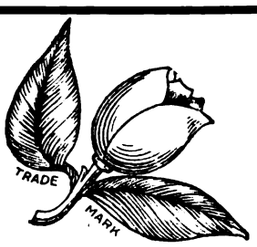

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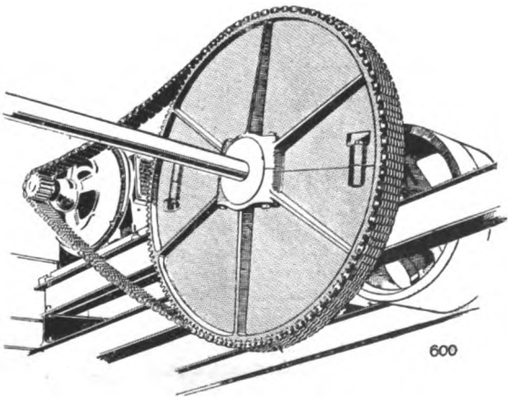

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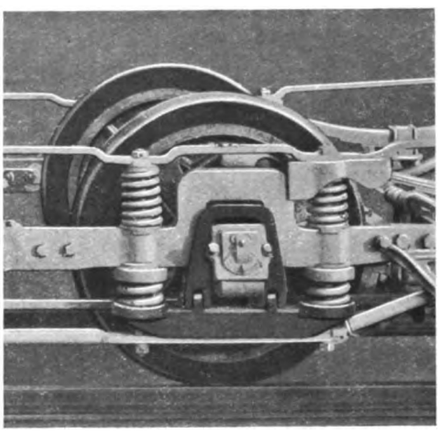

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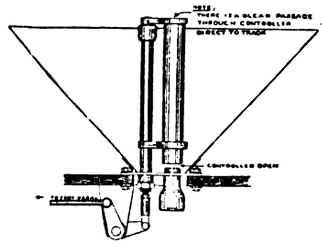

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(Continued on page xx.)

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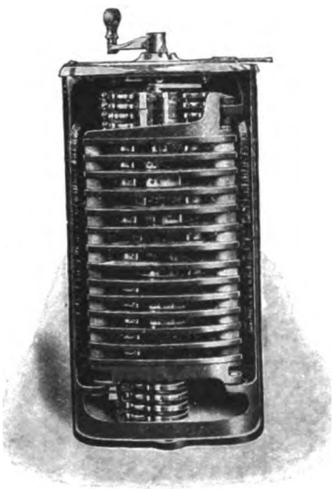

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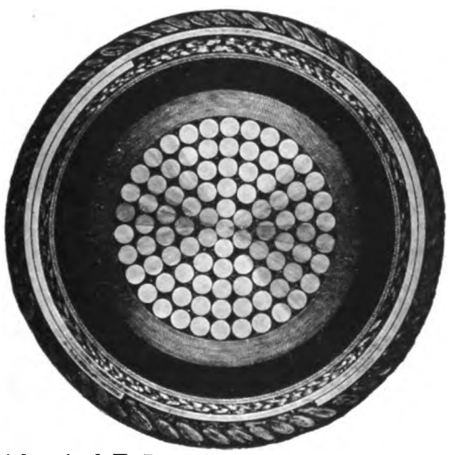

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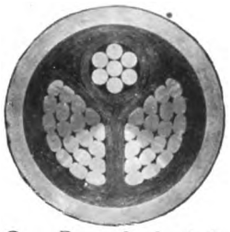

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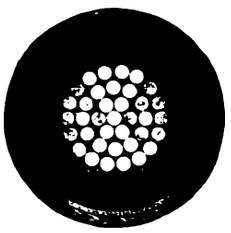

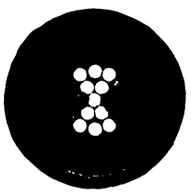

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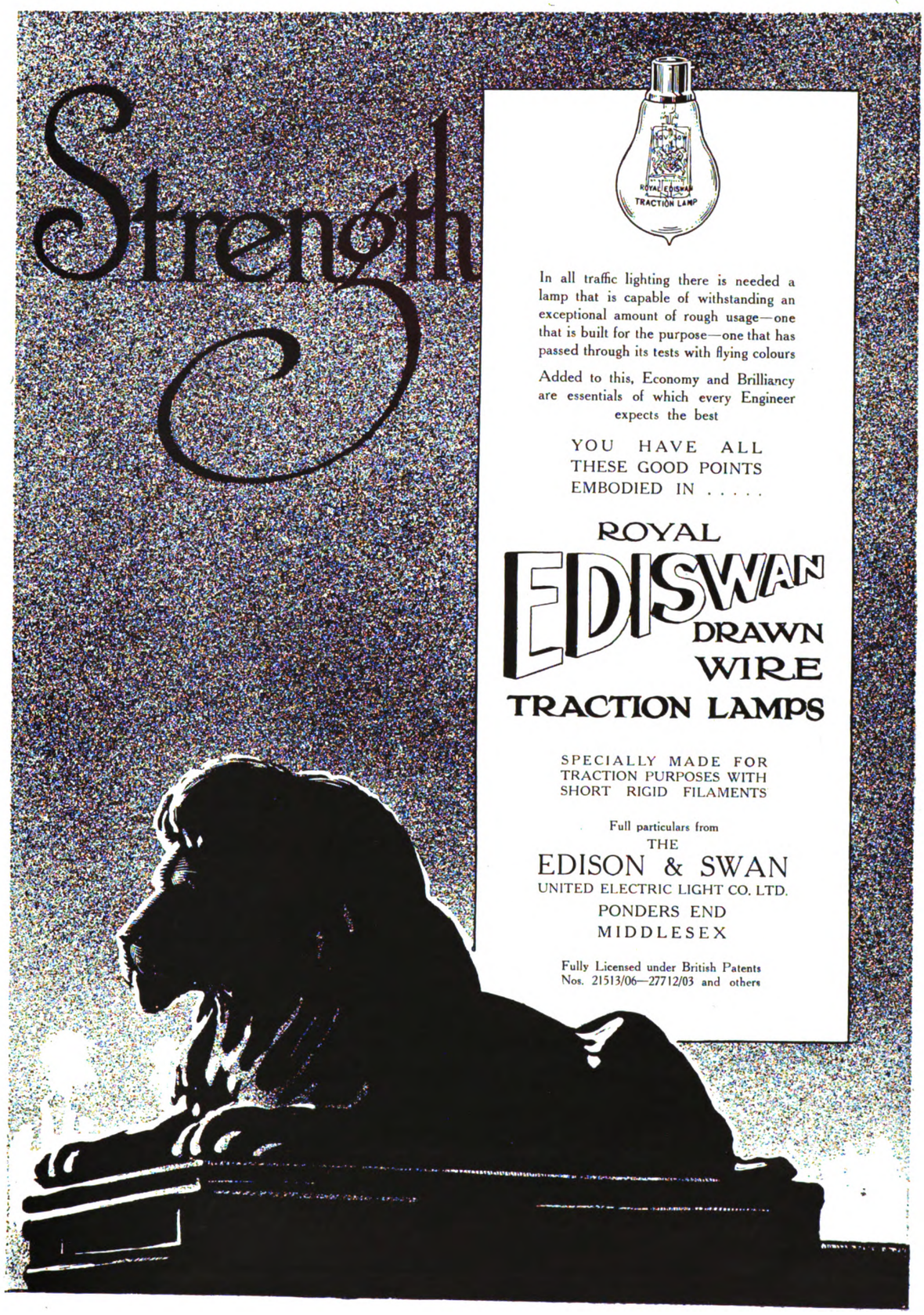

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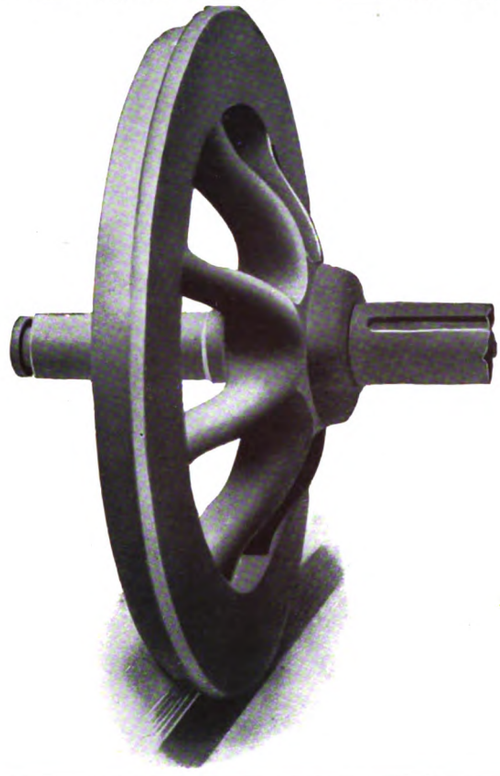

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NAMES OF PRINCIPAL OFFICERS,

POSTAL ADDRESS, TELEGRAPHIC ADDRESS, AND TELEPHONE NUMBERS.

MUNICIPAL TRAMWAYS, pp. xxiii-xxiv. COMPANY TRAMWAYS, pp. xxiv-xxvi. PARTICULARS OF TRACK AND EQUIPMENT, pp. xxvii-xxx.

TRAMWAY ASSOCIATIONS, p. xxvi.

Aberdare Urban District Tramways, Gadlys Estate, Aberdare. [T.A., Tramways, Aberdare: T.N., 17.] *Gen. Manager and Elec. Engineer*, A. J. Abraham; *Traffic Manager*, H. King; *Chairman Try. Com.*, Coun. E. Stonelake.

Aberdeen Corporation Tramways, Municipal Buildings, Union Street, Aberdeen. [T.A., Trams, Aberdeen; T.N. 826.] *Gen. Manager and Eng.*, R. S. Pilcher; *Per. Way Eng.*, Wm. Dyack; *Chairman Try. Com.*, Coun. Robertson.

Accrington Corporation Tramways, Market Hall, Accrington. [T.A., Trams, Accrington; T.N., 212.] *Gen. Manager and Eng.*, H. Pilling; *Per. Way Eng.*, W. J. Newton; *Chairman Try. Com.*, Ald. T. E. Higham; *Vice-Chairman*, Coun. Morley.

Ashton-under-Lyne Corporation Tramways, Tramway Depot, Mossley Road, Ashton. [T.A., Tramways, Ashton; T.N., 325.] *Gen. Manager*, Ernest Holt; *Elec. Eng.*, N. Appelbee; *Chairman Try. Com.*, Ald. R. S. Oldham; *Vice-Chairman*, Ald. Waterhouse.

Ayr Corporation Tramways, Town Building, Ayr. [T.A., Trams, Ayr; T.N., 123.] *Gen. Manager and Eng.*, William Grant; *Burgh Elec. Eng.*, R. Marshall; *Per. Way Eng.*, John Young; *Rolling Stock Supt.*, Alf. Somerville; *Convener Try. Com.*, Coun. J. R. Learmont; *Vice-Chairman*, Bailie Murray.

Bacup Corporation Tramways.—Town Hall, Bacup, Lancs. *Town Clerk*, J. Entwistle; *Boro' Eng.*, W. H. Elce; *Chairman Try. Com.*, Ald. Sir H. Maden; *Vice-Chairman*, Coun. J. H. Lord (Mayor).

Barking Town Urban District Tramways, East Street, Barking. [T.N., 156 Barking.] *Acting Engineer and Manager*, W. E. Kidner; *Chairman Try. Com.*, Coun. D. Gordon.

Barton-upon-Irwell District Council Light Railways, Barton-upon-Irwell.

[Line leased to and worked by the Lancashire United Tramways Co., *q.v.*]

Batley Corporation Tramways, Batley, Yorks. *Engineer*, S. D. Jones; *Chairman Try. Com.*, Coun. J. W. Turner; *Vice-Chairman*, Coun. F. W. H. Auty.

[Lines leased to and worked by the Yorkshire (Woollen District) Electric Tramways, Ltd., *q.v.*]

Belfast City Tramways, Tramways Office, Sandy Row, Belfast. [T.A., Nance, Tramway, Belfast; T.N., 2444.] *Gen. Manager*, Andrew Nance; *Traffic Manager*, R. McMaster; *City Elec. Eng.*, T. W. Bloxam; *Per. Way Eng.*, E. S. Pinkerton; *Chief Eng.*, A. A. Blackburn; *Chairman Try. Com.*, Ald. John Tyrrell, J.P.; *Vice-Chairman*, Coun. James A. Duff.

Bexley Urban District Council Tramways, Car Sheds, Bexleyheath, Kent. [T.A., Stokes, Tramways, Bexleyheath; T.N., 79.] *Gen. Manager and Elec. Eng.*, H. P. Stokes; *Rolling Stock Supt.*, A. Williams; *Chairman Try. Com.*, Coun. E. T. Coote; *Vice-Chairman*, Coun. E. F. Reid.

Birkenhead Corporation Tramways, Laird Street, Birkenhead. [T.A., Tramways Manager, Birkenhead; T.N., 1110.] *Gen. Manager*, C. Clarke; *Borough Sur. and Eng.*, C. Brownridge; *Rolling Stock Supt.*, R. Chadwick; *Chairman Try. Com.*, Coun. H. Halsall; *Vice-Chairman*, Coun. R. Frame.

Birmingham Corporation Tramways, The Council House, Congreve Street, Birmingham. [T.A., Trams, Birmingham; T.N., Central 7,000.] *Gen. Manager*, A. Baker; *City Elec. Eng.*, R. A. Chattock; *Traffic Supt.*, J. McDonnell; *Per. Way Eng.*, C. E. S. Bill; *Rolling Stock Supt.*, R. H. Dickinson; *Chairman Try. Com.*, Coun. H. Barrow, J.P.; *Vice-Chairman*, Coun. A. G. Ellaway.

Blackburn Corporation Tramways, 2, Salford, Blackburn. [T.A., Tramways, Blackburn; T.N., 547.] *General Manager*, J. H. Cowell; *Elec. Eng.*, P. P. Wheelwright; *Traffic Manager*, E. Greek; *Car Shed Supt.*, H. W. Seymour; *Chairman Try. Com.*, Ald. W. Thompson; *Vice-Chairman*, Coun. C. Higham.

Blackpool Corporation Tramways, West Caroline Street, Blackpool. [T.N., 67.] *Gen. Manager*, C. Furness; *Traffic Supt.*, C. J. Baker; *Resident Eng.*, F. Field; *Chairman Try. Com.*, Ald. J. Brodie, J.P.; *Vice-Chairman*, Ald. R. Holt (Mayor).

Bolton Corporation Tramways, Bradshawgate, Bolton. [T.A., Manager, Tramways, Bolton; T.N., 490.] *General Manager*, J. Barnard; *Elec. Eng.*, W. J. H. Wood; *Per. Way Eng.*, E. Ll. Morgan; *Rolling Stock Supt.*, F. Taylor; *Chairman Try. Com.*, Ald. J. Miles; *Vice-Chairman*, Coun. P. Higson.

Bootle Corporation Tramways, Electricity Works, Pine Grove, Bootle. [T.N., 424.] *Elec. Eng.*, T. D. Clothier; *Chairman Try. Com.*, Ald. Booth; *Vice-Chairman*, Coun. Pennington.

[Lines worked by Liverpool Corporation Tramways.]

Bournemouth Corporation Tramways, Tramways Offices, Lansdowne Crescent, Bournemouth [T.A., Tramways, Bournemouth; T.N., 1701.] *General Manager*, I. Bulfin; *Chief Assistant & Elec. Eng.*, H. Vickers; *Traffic Supt.*, R. O. Baldwin; *Chairman Try. Com.*, Coun. Bell *Vice-Chairman*, Coun. McCabe.

Bradford Corporation Tramways, Central Office, 7, Hall Ings, Bradford. [T.A., Tramways, Bradford; T.N., 2381 and 2382.] *Gen. Manager*, C. J. Spencer; *Asst. Elec. Eng.*, J. W. Dawson; *Traffic Supt.*, T. Stirk; *City Elec. Eng.*, T. Roles; *Chairman Try. Com.*, Coun. Enoch Priestley; *Vice-Chairman*, Coun. S. C. T. Newman.

Brighton Corporation Tramways, Lewes Road, Brighton. [T.A., Tramways, Brighton; T.N., 353 P.O.] *Eng. & Manager*, William Marsh; *Traffic Supt.*, W. N. Brooks; *Rolling Stock Supt.*, W. Orchard; *Per. Way Eng.*, F. N. Hudson; *Chairman Try. Com.*, Coun. Martin.

Burnley Corporation Tramways, Queen's Gate, Burnley. [T.N., 46.] *Gen. Manager*, Henry Mozley; *Boro. Elec. Eng.*, J. E. Starkie; *Boro. Surveyor*, G. H. Pickles; *Chairman Try. Com.*, Coun. E. Heap; *Vice-Chairman*, Coun. Irving.

Burton-on-Trent Corporation Tramways, Guild Street, Burton-on-Trent. [T.N., 202.] *Manager*, A. B. Slater; *Engineer*, T. Hall; *Chairman Try. Com.*, Ald. J. S. Rowland (Mayor); *Vice-Chairman*, Ald. T. E. Lowe.

Bury Corporation Tramways, Market Place, Bury. [T.N., 26.] *Gen. Manager*, William Clough; *Boro. Elec. Eng.*, S. J. Watson; *Chairman Try. Com.*, Ald. T. S. Collinge; *Vice-Chairman*, Coun. Hargreaves.

Cardiff Corporation Tramways, Central Offices, The Hayes, Cardiff. [T.A., Tramways, Cardiff; T.N., 1211, 1240, 1350, and 377.] *Gen. Manager and Elec. Eng.*, A Ellis; *Traffic Manager*, H. David; *Per. Way Eng.*, W. Harpur; *Rolling Stock Supt.*, Jas. Preston; *Chairman Try. Com.*, Ald. Sir J. W. Courtis, J.P.; *Vice-Chairman*, Coun. A. J. A. Stone.

Chester Corporation Tramways, Station Road, Chester. [T.N., 166.] *Traffic Manager*, W. H. Ellis; *Elec. Eng.*, S. E. Britton; *Per. Way Eng.*, W. M. Jones; *Chairman Try. Com.*, Ald. J. Jones; *Vice-Chairman*, Coun. A. S. Dutton.

Chesterfield Corporation Tramways, Chatsworth Road, Chesterfield. [T.A., Tramways, Chesterfield; T.N., 78.] *Gen. Manager and Elec. Eng.*, R. L. Acland; *Traffic Manager*, F. Root; *Per. Way Eng.*, C. E. Crossley; *Chairman Try. Com.*, Ald. E. Shentall (Mayor); *Vice-Chairman*, Coun. Woodhead.

Colchester Corporation Tramways, Magdalen Street, Colchester. [T.A., Tramways, Colchester; T.N., 92.] *Gen. Manager and Engineer*, R. C. Bullough; *Chairman Try. Com.*, Coun. A. M. Jarmin; *Vice-Chairman*, Coun. J. T. Bailey.

Colne Corporation Tramways, Colne, Lancashire. *General Manager*, T. G. Richardson.

Coventry Corporation Tramways, Priestley's Bridge, Coventry. [T.A., Tramways, Coventry; T.N., 1014.] *Engineer and General Manager*, T. R. Whitehead; *Electrical Engineer*, W. M. Milnes; *Chairman*, Coun. C. V. Pugh; *Vice-Chairman*, Coun. H. W. Wale

Croydon Corporation Tramways, Tramways Office, Thornton Heath, Surrey. [T.A., Tramways, Croydon; T.N., 406, Croydon.] *Tramways Manager*, T. B. Goodyer; *Chairman Try. Com.*, Ald. G. J. Allen; *Vice-Chairman*, Coun. A. A. Thomson.

Darlington Corporation Tramways, Haughton Road, Darlington. [T.A., Tramways, Darlington; T.N., 185.] *General Manager and Elec. Eng.*, J. R. P. Lunn; *Traffic Manager*, —— Fraser; *Chairman Try. Com.*, Ald. C. W. Starmer.

Dartford Urban District Council Tramways, Dartford. *Chairman Try. Com.*, Coun. R. Bennett; *Vice-Chairman*, Coun. J. B. Walton.

[Leased. See Dartford Tramways in list of Tramway Companies.]

Darwen Corporation Tramways, Lorne Street, Darwen. [T.N., 104.] *Gen. Manager and Eng.*, F. J. S. Hosken; *Boro. Elec. Eng.*, C. H. Garnett; *Boro. Surveyor and Eng.*, ——————; *Chairman Try. Com.*, Ald. Jas. Tomlinson; *Vice-Chairman*, Coun. G. P. Holden.

Derby Corporation Tramways, 4, Victoria Street, Derby. [T.N., 410.] *Gen. Manager*, F. Harding; *Elec. Eng.*, T. P. Wilmshurst; *Per. Way Eng.*, J. Ward; *Chairman Try. Com.*, Coun. J. Dean.

Doncaster Corporation Tramways, Grey Friar's Road, Doncaster. [T.A., Rayner, Doncaster, T.N., 43.] *Manager & Elec. Eng.*, E. S. Rayner; *Chairman Try. Com.*, Coun. P. Stirling (Mayor); *Vice-Chairman*, Coun. Balmforth.

Dover Corporation Tramways, Town Hall, Dover. [T.A., Trams, Dover; T.N., 219 D.] *Gen. Manager*, E. Carden; *Per. Way Eng.*, W. C. Hawke (Boro. Surveyor); *Chairman Try. Com.*, Coun. Barwick; *Vice-Chairman*, Coun. Norman.

Dundee Corporation Tramways, Town House Buildings, Dundee. [T.N., 1340]; *Gen. Manager and Eng.*, Peter Fisher; *Elec. Eng.*, H. Richardson; *City Eng.*, J. Thomson; *Chairman Try. Com.*, Coun. G. A. Johnston.

East Ham (Borough of) Corporation Tramways, Nelson Street, East Ham. [T.N., 611 and 100, East Ham.] *Gen. Manager and Elec. Eng.*, W. C. Ullmann *Chairman Try. Com.*, Ald. M. Oakes.

Eccles Corporation Tramways, Eccles. *Elec. Eng.*, H. W. Angus; *Per. Way Eng.*, T. S. Picton; *Chairman Try. Com.*, Ald. W. J. Nuttall, J.P.; *Vice-Chairman*, Coun. Alexander.

[Lines worked by Salford Corporation.]

Erith Urban District Council Tramways, Tramway Depôt, Walnut Tree Road, Erith. [T.A., Tramways, Erith; T.N., 36.] *Gen. Manager and Elec. Engineer*, J. C. Williams; *Cons. Engs.*, Hawtayne and Zeden; *Chairman Try. Com.*, Coun. G. C. Humphreys.

Exeter Corporation Tramways, Paris Street, Exeter. *Manager*, H. C. Bartlett; *Elec. Eng.* H. D. Munro; *Per. Way Eng.*, T. Moulding; *Chairman Try. Com.*, Ald. H. B. Varwell; *Vice-Chairman*, Coun. F. G. Towill.

Farnworth Urban District Council Tramways, Albert Road, Farnworth. *Chairman Try. Com.*, Coun. W. B. Richardson; *Vice-Chairman*, Coun. Stones.

[Lines leased to the South Lancashire Tramways Co.]

Glasgow Corporation Tramways, 46, Bath Street, Glasgow. [T.A., Trams, Glasgow; T.N., 1040, Douglas.] *Gen. Manager*, J. Dalrymple; *Traffic Supt.*, L. Mackinnon; *Chief Eng.*, J. Ferguson; *Elec. Eng.*, E. T. Goslin; *Sec.*, J. N. Wilson; *Chairman Try. Com.*, ——————; *Vice-Chairman*, Coun. Montgomery.

Gloucester Corporation Light Railway, Bristol Road Depôt, Gloucester. [T.A., Tramways, Gloucester; T.N. 155.] *Gen. Manager and Elec. Eng.*, F. H. Corson; *Chairman Try. Com.*, Coun. J. O. Roberts; *Vice-Chairman*, Coun. C. J. Ramstedt.

Great Yarmouth Corporation Tramways, Caister Road, Great Yarmouth. [T.N. 265.] *Gen. Manager*, F. L. Turner; *Elec. Eng.*, Gordon Bryant *Per. Way. Eng.*, J. W. Cockrill (Borough Surveyor); *Chairman Try. Com.*, Coun. J. T. C. Salmon.

Halifax Corporation Tramways, Skircoat Road, Halifax. [T.N., 36 and 382.] *Traffic Manager*, Jas. D. Caird; *Try. Eng.*, J. W. Galloway; *Per. Way Eng.*, J. Lord (Boro. Eng.); *Chairman Try. Com.*, Ald. C. F. Spencer; *Vice-Chairman*, Ald. A. Fawcett.

Haslingden Corporation Tramways, John Street, Haslingden. *Gen. Manager and Elec. Eng.*, Barnes Kay; *Per. Way Eng.*, J. S. Green (Borough Surveyor); *Chairman Try. Com.*, Coun. Waddington; *Vice-Chairman*, Coun. Haworth.

Herne Bay Pier Tramway (owned and worked by Herne Bay U.D.C.), Herne Bay. [T.N., 22.] *Res. Eng. and Manager*, H. C. Dufton.

Heywood Corporation Tramways, Heywood, Lancs. [T.N., 37.] *Gen. Manager*, J. Stott; *Per. Way Eng.*, J. A. Settle; *Chairman Try. Com.*, Coun. J. Ashworth; *Vice-Chairman*, Ald. T. Popple, J.P.

Huddersfield Corporation Tramways, Northumberland Street, Huddersfield. [T.N., 698 and 398.] *Gen. Manager & Elec. Eng.*, R. H. Wilkinson; *Assist. Engineer*, A. P. Quilliam; *Traffic Supt.*, T. Hartley; *Borough Eng.*, K. F. Campbell; *Chairman Try. Com.*, Ald. J. H. Aston; *Vice-Chairman*, Coun. J. Barlow.

Hull Corporation Tramways, Alfred Gelder Street, Hull. [T.N., 444, Corporation.] *Manager*, Wm. J. McCombe; *Elec. Eng.*, J. Wilkinson; *Per. Way Eng.*, F. W. Bricknell (*City Engineer*); *Rolling Stock Supt.*, ; *Chairman Try. Com.*, Ald. J. H. Hargreaves (Lord Mayor); *Vice-Chairman*, Coun. W. Wheatley.

Ilford Urban District Council Tramways, Ley Street, Ilford. [T.N., 684.] *Manager*, L. E. Harvey; *Traffic Manager*, A. Woolstencroft; *Works Supt.*, H. H. Simpson; *Chairman Try. Com.*, Coun. W. J. T. Cullis; *Vice-Chairman*, Coun. Owen Waters.

Ilkeston Corporation Tramways, Park Road, Ilkeston. [T.A., Bellamy Ilkeston; T.N., 26.] *Manager and Elec. Eng.*, L. C. F. Bellamy; *Chairman Try. Com.*, Coun. J. E. Bestwick; *Vice-Chairman*, Coun. Kane.

Ipswich Corporation Tramways, Constantine Road, Ipswich. [T.A., Ayton, Tramways, Ipswich; T.N., 354.] *Gen. Manager and Elec. Eng.*, Frank Ayton; *Traffic Supt.*, A. Butler; *Rolling Stock Supt.*, W. A. Fairhead; *Chairman Try. Com.*, Coun. E. C. Ransome; *Vice-Chairman*, W. P. Burton.

Kearsley Urban District Council Tramways, Council Office, Kearsley, Farnworth, S.O. *Clerk U. D. C.*, H. Martin.

[Lines leased to and worked by the South Lancashire Tramways Co.]

Keighley Corporation Tramways, South Street, Keighley. [T.A., Tramways, Keighley; T.N., 17.] *Gen. Manager and Elec. Eng.*, H. Webber; *Chairman Try. Com.*, Coun. A. Smith.

Kilmarnock Corporation Tramways Electricity Works, Kilmarnock. [T.N., 95.] *Elec. Eng. and Manager*, W. C. Bexon; *Consulting Engineers*, Kennedy and Jenkin; *Convener Try. Com.*, Bailie Jones.

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ELECTRIC TRAMWAYS IN THE UNITED KINGDOM.

Kirkcaldy Corporation Tramways, Electricity Works Victoria Road, Kirkcaldy. [T.A., Tramways, Kirkcaldy. T.N., 124, 174, and 175.] *Manager & Elec. Eng.*, O. F. Francis; *Traffic Manager*, Jas. Fisher; *Chairman Try. Com.*, Coun. G. Fergusson.

Lancaster Corporation Tramways, Electricity Works, Lancaster. [T.A., Milnes, Tramways, Lancaster; T.N., 1, L.] *Gen. Manager & Elec. Eng.*, G. C. Milnes; *Traffic Manager*, W. T. Charlton; *Chairman Try. Com.*, Coun. T. Wilkinson.

Leeds City Tramways, Standard Buildings, City Square, Leeds. [T.A., Tramways, Leeds; T.N., 44 and 169; *General Manager*, J. B. Hamilton; *Traffic Supt.*, A. Daggett; *Elec. Eng.*, John Burbridge; *Per. Way Eng.*, R. B. Holt; *Car Works Supt.*, G. E. Watmough; *Chairman Try. Com.*, Ald. R. A. Smithson; *Vice-Chairman*, Ald. H. Brown.

Leicester Corporation Tramways, 20 and 22, Humberstone Gate, Leicester. [T.N., 2177.] *Manager & Sec.*, A. F. Lucas; *Boro. & Try. Eng.*, E. G. Mawbey; *Elec. Eng.*, T. R. Smith; *Cons. Engs.*, Kincaid, Waller, & Manville; *Chairman Try. Com.*, Ald. S. Flint, J.P.; *Vice-Chairman*, Ald. G. Banton, J.P.

Leith Corporation Tramways, 165, Leith Walk, Leith. [T.N., 415.] *Gen. Manager*, F. A. Fitzpayne; *Per. Way Eng.*, J. R. Findlay (*Burgh Eng.*); *Chairman Try. Com.*, Judge Hall.

Leyton District Council Tramways, Car Depot, Lea Bridge Road, Leyton, E. [T.A., Tramways, Leyton; T.N., 17 Walthamstow.] *Manager*, F. Schofield; *Elec. Eng.*, F. Harman Lewis; *Per. Way Eng.*, E. H. Essex; *Chairman Try. Com.*, Coun. J. A. Hennah.

Lincoln Corporation Tramways, Brayford Side North, Lincoln. [T.A., Stanley Clegg, Lincoln; T.N., 109]. *General Manager and Elec. Eng.*, Stanley Clegg; *Chairman Try. Com.*, Ald. W. S. White; *Vice-Chairman*,

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Liverpool Corporation Tramways, 24, Hatton Garden, Liverpool. [T.A., Tramways, Liverpool; T.N., 6054 and 7701, Central.] *General Manager*, C. W. Mallins; *Per. Way Eng.*, J. A. Brodie (*City Engineer*); *City Electrical Engineer*, Harold Dickinson; *Rolling Stock Supt.*, T. Ridyard; *Chairman Try. Com.*, Coun. E. Russell Taylor; *Vice-Chairman*, Ald. F. Smith, J.P.

London County Council Tramways, 62, Finsbury Pavement, London, E.C. [T.A., Lotram, London; T.N., 3321, 3322, and 3323 London Wall.] *Chief Officer*, A. L. C. Fell; *Deputy Chief Officer*, J. K. Bruce; *Elec. Assist.*, J. Shepherd; *Traffic Assist.*, L. Slattery; *Rolling Stock Supt.*, W. E. Ireland; *Per. Way Eng.*, J. Welling; *Chairman Highways Com.*, W. J. Squires, J.P.; *Vice-Chairman*, T. Prestige.

Lowestoft Corporation Tramways, Norwich Road, Lowestoft. [T.N., 87.] *Gen. Manager*, H. H. Saunders; *Elec. Eng.*, W. R. May; *Chairman Try. Com.*, Coun. F. Spashett.

Maidstone Corporation Tramways, Tramway Offices, Tonbridge Road, Maidstone. [T.A., Lambert, Tramways, Maidstone; T.N., 72 B.] *Gen. Manager and Elec. Eng.*, A. T. Lambert; *Cons. Eng.*, S. Sellon; *Chairman Try. Com.*, Ald. Vaughan; *Vice-Chairman*, Coun. Green.

Manchester Corporation Tramways, 55, Piccadilly, Manchester. [T.A., Tramways, Manchester; T.N., 7800 City.] *Gen. Manager*, J. M. McElroy; *Traffic Sup.*, J. T. Oakes; *Elec. Eng.*, J. J. McMahon; *Chief Civil Eng.*, H. Mattinson; *Rolling Stock Supt.*, G. R. Blackburn; *Chairman Try. Com.*, Ald. J. Bowes; *Vice-Chairman*, Ald. A. W. Chapman.

Middlesex County Council Light Railways, Middlesex Guildhall, Westminster, London, S.W. *County Eng.*, H. T. Wakelam, M.I.C.E.; *Chairman of Light Railways Com.*, County Ald. H. Burt; *Vice-Chairman*, County Coun. F. Goodyear.

Middleton Corporation Tramways. *Consulting Engs.*, Lacey, Sillar, and Leigh; *Chairman Try. Com.*, Ald. W. Wood, J.P. (Mayor); *Vice-Chairman*, Ald. Bentley, J.P.
[Worked by Manchester Corporation Tramways.]

Nelson Corporation Light Railways, Charles Street, Nelson. [T.N., 115.] *Manager and Elec. Eng.*, G. F. Nayler; *Per. Way Eng.*, W. Shackleton; *Chairman Try. Com.*, Coun. W. F. Cooke.

Newcastle-upon-Tyne Corporation Tramways, Manors, Newcastle. [T.A., Traction, Newcastle; T.N., 913 and 914 Central.] *Gen. Manager & Engineer*, Ernest Hatton; *Traffic Supt.*, T. Chalder; *Per. Way Eng.*, W. J. Steele; *Chairman Try. Com.*, Coun. R. Mayne; *Vice-Chairman*, Coun. A. M. Sutherland.

Newport (Mon.) Corporation Tramways, Town Hall, Newport, Mon. [T.A., Dynamo, Newport, Mon.; T.N., 990 L., Nat.] *Gen. Manager*, N. J. Young; *Boro. Elec. and Per. Way Eng.*, A. Nichols Moore; *Chairman Try. Com.*, Coun. J. Moxon; *Vice-Chairman*, Ald. F. Phillips.

Northampton Corporation Tramways. St. James', Northampton. [T.N., 279 & 280.] *Gen. Manager and Elec. Eng.*, J. F. Cameron; *Chairman Try. Com.*, Coun. T. D. Lewis; *Vice-Chairman*, Coun. W. Beale.

Nottingham Corporation Tramways, Beastmarket Hill, Nottingham. [Tramways, Nottingham; T.N., 225.] *General Manager & Elec. Eng.*, John Aldworth; *Traffic Supt.*, H. Morley; *Per. Way Eng.*, Arthur Brown (*City Eng.*); *Rolling Stock Supt.*, W. Boot; *Chairman Try. Com.*, Coun. R. H. Swain; *Vice-Chairman*, Ald. F. R. Radford.

Oldham Corporation Tramways, Wallshaw Depot, Oldham. [T.A., Tramways, Oldham; T.N., 1495.] *Gen. Manager & Eng.*, J. W. Dugdale; *Traffic Supt.*, J. Brierley; *Chairman Try. Com.*, Ald. F. G. Isherwood; *Vice-Chairman*, Coun. F. Elliot.

Perth Corporation Tramways, Electricity Works, Perth. [T.N., 226 & 101.] *Tramways Manager*, W. G. Snell; *Elec. & Tramways Eng.*, John Lambert; *Per. Way Eng.*, R. McKillop (*Burgh Surv.*); *Chairman Try. Com.*, Coun. Calderwood.

Plymouth Corporation Tramways, 15, Ebrington Street, Plymouth. [T.N. 518, Plymouth.] *General Manager*, C. Everson; *Elec. Eng.*, E. J. Okell; *Chairman Try. Com.*, Ald. S. H. Phillips, J.P.; *Vice-Chairman*, Coun. J. Moon.

Pontypridd Urban District Tramways, Generating Station, Treforest, Pontypridd. [T.N. 33.] *Gen. Manager and Elec. Eng.*, J. E. Teasdel; *Traffic Inspector*, W. May; *Per. Way Eng.*, W. E. Lowe (*Surveyor*); *Chairman Try. Com.*, Coun. M. L. Jones.

Portsmouth Corporation Tramways, Town Hall, Portsmouth. [T.N., 110 Corporation.] *Gen. Manager*, W. R. Spaven; *Elec. and Per. Way Eng., and Rolling Stock Supt.*, V. G. Lironi; *Traffic Supt.*, W. Munford; *Chairman Try. Com.*, Ald. J. H. Corke, J.P. (Mayor); *Vice-Chairman*, Coun. J. Timpson.

Preston Corporation Tramways, Holmrook Road, Preston. [T.A., Corporation Tramways, Preston; T.N., 273.] *Gen. Manager and Elec. Eng.*, J. F. Simpson; *Traffic Supt.*, E. Lafferty; *Chairman, Try. Com.*, Ald. J. Ormrod; *Vice-Chairman*, Coun. T. Parkinson.

Radcliffe Urban District Council Tramways, Council Offices, Radcliffe, Lancs. *Res. Eng.*, H. Wilkinson; *Per. Way Eng.*, W. L. Rothwell; *Clerk*, S. Mills; *Chairman Try. Com.*, Coun. Walker Allen, J.P.
[These tramways are worked as part of the Bury system.]

Rawtenstall Corporation Tramways, Bacup Road, Rawtenstall. [T.N., 81 and 85.] *Gen. Manager and Elec. Eng.*, C. L. E. Stewart; *Chairman Try. Com.*, Ald. H. Coupe, J.P.; *Vice-Chairman*, Coun. J. W. Stansfield.

Reading Corporation Tramways, Mill Lane, Reading. [T.A., Tramways Manager, Reading; T.N., 380.] *Gen. Manager & Elec. Eng.*, G. F. Craven; *Chairman Try. Com.*, Ald. C. G. Field, J.P. (Deputy Mayor).

Rochdale Corporation Tramways, Mellor Street, Rochdale. [T.A., Tramways, Rochdale; T.N., 48.] *Gen. Manager & Eng.*, G. Webster; *Traffic Manager*, R. Bentley; *Rolling Stock Supt.*, E. Sidgwick; *Chairman Try. Com.*, Ald. Taylor.

Rotherham Corporation Tramways, Rawmarsh Road, Rotherham. [T.A., Cross, Rotherham; T.N., 138, 152, and 241.] *General Manager & Elec. Eng.*, E. Cross; *Deputy Elec. Eng.*, J. Williams; *Traffic Manager*, H. Jagger; *Per. Way Eng.*, E. B. Martin; *Rolling Stock Supt.*, C. A. Walker; *Chairman Try. Com.*, Ald. D. L. Winter; *Vice-Chairman*, Coun. T. Reeves.

St. Helens Corporation Tramways, Town Hall, St. Helens, Lancs. *Chairman Try. Com.*, Ald. Sir J. Beecham; *Vice-Chairman*, Coun. W. N. Pilkington.
[Lines worked by the New St. Helens and District Tramways Co.]

Salford Corporation Tramways, 32, Blackfriars Street, Salford. [T.A., Tramways, Salford; T.N., 5367 and 5368 Central.] *Gen. Manager*, Geo. W. Holford; *Elec. Eng.*, H. J. Hawkins; *Traffic Supt.*, W. Blakemore; *Per. Way Supt.*, H. Richardson; *Rolling Stock Supt.*, R. Chadwick; *Chairman Try. Com.*, Ald. H. Linsley, J.P.; *Vice-Chairman*, Coun. W. H. Barrett.

Sheffield Corporation Tramways, 8, Division Street, Sheffield. [T.A., Tramways, Sheffield; T.N., 4600.] *General Manager*, A. R. Fearnley; *Elec. Eng.*, H. E. Yerbury; *Traffic Supt.*, A. Handford; *Per. Way Eng.*, W. J. Hadfield; *Rolling Stock Supt.*, J. Smith; *Chairman Try. Com.*, Ald. Sir W. Clegg, J.P.; *Vice-Chairman*, Coun. A. T. Bescoby, J.P.

Shipley Urban District Tramway, Dockfield, Shipley. [T.A., Electricity Works, Shipley; T.N., 190.] *Elec. Eng.*, ; *Chairman Try. Com.*, H. Pitts.
[Lines leased to Bradford Corporation.]

Southampton Corporation Tramways, 161, Above Bar, Southampton. [T.A., Tramways, Southampton; T.N., 301.] *Gen. Manager*, W. T. Robson; *Boro. Elec. Engineer*, H. F. Street; *Traffic Manager*, G. H. Simpson; *Chairman Try. Com.*, Ald. F. A. Dunsford, J.P.

Southend-on-Sea Corporation Tramways, London Road, Southend-on-Sea. [T.N., 96.] *Gen. Manager and Elec. Eng.*, R. Birkett; *Traffic Manager*, J. Daniells; *Per. Way Eng.*, E. J. Elford (*Boro. Surveyor*); *Rolling Stock Supt.*, J. Dobson; *Chairman Try. Com.*, Ald. A. Martin.

Southend Pier Electric Railway, (owned and worked by Southend-on-Sea Corporation), [T.A., Piermaster, Southend; T.N., 91.] Southend-on-Sea. *Elec. Eng.*, C. R. Norton; *Piermaster*, Capt. N. E. Hucker; *Chairman*, Coun. H. Dowsett.

Southport Corporation Tramway, 44, Chapel Street, Southport. [T.N., 116.] *Gen. Manager*, T. J. Kendrew; *Boro' Elec. Eng.*, A. S. Black; *Chairman Try. Com.*, Ald. Griffiths, J.P.; *Vice-Chairman*, Coun. Clayton.

South Shields Corporation Tramways, Dean Road, South Shields. [T.A., Tramways, South Shields; T.N., 157.] *Gen. Manager & Elec. Eng.*, J. C. Whiteley; *Boro. Elec. Eng.*, H. S. Ellis; *Chairman Try. Com.*, Ald. W. G. Wylie; *Vice-Chairman*, Ald. J. W. Henderson.

Stalybridge Hyde, Mossley, and Dukinfield Tramways and Electricity Board, Waterloo Road, Stalybridge. [T.N., 311.] *Commercial Manager*, F. Schofield; *Chief Eng.*, R. Blackmore; *Chairman Try. Com.*, Ald. R. Wood; *Vice-Chairman*, Coun. S. C. Homer.

Stockport Corporation Tramways, Mersey Square, Stockport. [T.N., 232 and 237.] *Manager*, A. T. Eardley; *Elec. Eng.*, R. Lomax; *Chairman Try. Com.*, Ald. Chas. Sharples; *Vice-Chairman*, Ald. W. E. Hampett.

Sunderland Corporation Tramways, Tramway Offices, Monkwearmouth, Sunderland. [T.A., Trys. Manager, Sunderland; T.N., 948.] *Gen. Manager and Elec. Eng.*, A. R. Dayson; *Chairman Try. Com.*, Coun. G. New, J.P.; *Vice-Chairman*, Coun. W. Walker.

Swindon Corporation Tramways, Electricity Works, Swindon. [T.A., Tramways, Swindon; T.N., 4.] *Manager*, T. Medcalf; *Elec. Eng.*, A. Dimmack; *Consulting Engs.*, Lacey, Sillar, & Leigh; *Chairman Try. Com.*, Coun. A. D. Richards; *Vice-Chairman*, Coun. A. Bull.

Wallasey Corporation Tramways, Seaview Road, Wallasey. [T.A., Tramways, Liscard; T.N., 1431, Liscard.] *General Manager*, R. R. Greene; *Elec. Eng.*, J. H Crowther; *Per. Way Eng.*, W. H. Travers; *Chairman Try. Com.*, Coun. F. E. Howse; *Vice-Chairman*, Coun. H. W. Griffin.

Walsall Corporation Tramway, St. Paul's Buildings, The Bridge, Walsall. [T.A., Tramways, Walsall; T.N., 238 & 559.] *Gen. Manager*, R. L. Horsfield; *Elec. Eng.*, H. A. Howie; *Per. Way Eng.*, J. Taylor (*Boro. Surveyor*); *Chairman, Try. Com.*, Ald. J. Cope; *Vice-Chairman*, Ald. J. Williams.

Walthamstow Urban District Council Tramways, Chingford Road, Walthamstow, [T.A., Tramways, Walthamstow; T.N., 20.] *Tramways Manager*, W. Murray; *Elec. Eng.*, G. R. Spurr (Priory Avenue, Walthamstow); *Per. Way Eng.*, G. W. Holmes; *Chairman Trys. Com.*, Coun. Clarke; *Vice-Chairman*, Coun. R. J. Bishop.

Warrington Corporation Tramways, Mersey Street, Warrington. [T.N., 196] *Gen. Manager*, J. Telfer; *Elec. Eng.*, F. V. L. Mathias; *Chairman Try. Com.*, Coun. Dr. G. W. Joseph; *Vice-Chairman*, Coun. J. Wilkinson.

West Bromwich Corporation Tramway, Electricity Works, West Bromwich. [T.N., 100.] *Boro. Eng.*, A. D. Greatorex; *Boro. Elec. Eng.*, W. A. Jackson; *Chairman Try. Com.*, Ald. A. G. Turley, J.P. (Mayor); *Vice-Chairman*, Coun. G. Garratt.
[These tramways are leased to the South Staffs. (Lessee) Co., Ltd.]

West Ham Corporation Tramways, Greengate Street, Plaistow, London, E. [T.A., Trameurs, Plais., London; T.N., 868 East.] *General Manager*, J. S. D. Moffet; *Boro' Elec. Eng.*, J. W. Beauchamp; *Per. Way Eng.*, J. G. Morley (*Boro. Eng.*); *Chairman Try. Com.*, Ald. H. W. Littler.

West Hartlepool Corporation Tramways, Cleveland Road, West Hartlepool. [T.N., 6073.] *Gen. Manager & Eng*, Chas. Burgess; *Chairman Try. Com.*, Ald. Martin; *Vice-Chairman*, Coun. Charlton.

Wigan Corporation Tramways, Market Place, Wigan; [T.N., 226.] *Gen. Manager*, F. Buckley; *Per. Way Eng.*, A. T. Gooseman; *Chairman Try. Com.*, Ald. R. Fletcher; *Vice-Chairman*, Coun. J. Walkden.

Wolverhampton Corporation Tramways, Municipal Tramway Offices, Cleveland Road, Wolverhampton. [T.N., 324.] *Gen. Manager*, ——————; *Tramways Eng. and Deputy Gen. Manager*, C. O. Silvers; *Boro. Elec. Eng.*, S. T. Allen; *Per. Way Eng.*, George Green; *Chairman Try. Com.*, Ald. Sir C. T. Mander, Bart., J.P.; *Vice-Chairman*, Ald. S. Craddock, J.P.

York Corporation Tramways, 8, Clifford Street, York. [T.N., 302]. *Gen. Manager and Elec. Eng.*, J. W. Hame; *Traffic Supt.*, J. W. Horton; *Per. Way Eng.*, F. W. Spurr (City Surveyor); *Chairman Try. Com.*, Ald. S. W. Meyer; *Vice-Chairman*, Coun. W. H. Sessions.

COMPANY TRAMWAYS.

Aberdeen Suburban Tramways Company, 15, Golden Square, Aberdeen. [T.A., Judicial, Aberdeen; T.N., 447.] *Manager*, A. Wilkie; *Sec.*, G. Duncan; *Chairman*, James Mearns; *Directors*, W. Jackson, Dr. Christie, Jas. Sellar.

Airdrie and Coatbridge Tramways Company, Tramway Depôt, Main Street, Coatbridge [T.N., 105], and Electrical Federation Offices, Kingsway, London, W.C. *Gen. Manager*, A. Robertson; *Sec.*, P. N. Gray; *Chairman*, W. L. Madgen; *Directors*, H. S. Day, A. C. Miles.

Barnsley and District Electric Traction Company, Ltd., Car Depot, Sheffield Road, Barnsley. [T.A., Tramways, Barnsley; T.N., 159.] *Manager and Eng.*, P. H. Marco, A.I.E.E.; *Sec.*, S. M. Wright; *Chairman*, E. Garcke; *Directors*, Col. Sir Thomas Pilkington, Bart., E. A. Paris.

Barrow-in-Furness Tramways, Salthouse Road Depot, Barrow, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramways, Barrow; T.N., 125.] *Manager*, W. F. Bladon; *Sec.*, T. Phillips-Conn; *Chairman*, H. S. Day; *Directors*, J. V. Kitchener, E. R. Soames.

Bath Electric Tramways Company, Ltd., Walcot Street, Bath, and 119-125, Finsbury Pavement, London, E.C. [T.A., Trams, Bath; T.N., 214.] *Gen. Manager and Eng.*, W. E. Hardy; *Traffic Supt.*, E. Seckington; *Sec.*, H. J. Almond; *Chairman*, Hon. Sir J. Sivewright, K.C.M.G.; *Directors*, H. F. Clutterbuck, E. H. R. Trenow, A. A. C. Swinton, E. Callaird.

Bessbrook and Newry Tramway Company, Bessbrook, Co. Armagh. [T.A., Tramways, Bessbrook.] *Manager*, Robert Caven; *Elec. Eng.*, J. L. D. Meares; *Chairman*, J. N. Richardson; *Directors*, C. H. Richardson, R. T. Scott, T. W. Richardson, T. McGreggor Greer.

Birmingham District Power and Traction Company (section of the Birmingham and Midland Tramways Joint Committee), Power Station, Downing Street, Smethwick, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Power Station, Smethwick; T.N., 65 Smethwick.] *Electrical Eng.*, S. A. Mahood; *Gen. Manager*, W. G. Bond; *Secretary*, B. Kingsford; *Chairman*, C. Shirreff Hilton; *Directors*, J. A. Lycett, W. L. Madgen, S. R. Blundstone.

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ELECTRIC TRAMWAYS IN THE UNITED KINGDOM.

Blackpool and Fleetwood Tramroad Company, Ltd., Bispham, near Blackpool. [T.A., Cameron, Blackpool; T.N., 121.] *General Manager and Secretary*, J. Cameron; *Elec. Eng.*, A. Cameron; *Chairman*, John Greenwood; *Directors*, R. H. Prestwich, R. B. Barningham, R. S. Boddington, G. Richardson, G. Readman.

Blackpool and Fylde Light Railway Company, 5, Clifton Street, Blackpool. (No appointment of engineer or officials yet made.) *Secretary*, R. Bibby; *Chairman*, John Greenwood; *Directors*, T. Fisher, J.P., John Platt, J.P., W. Hardman, J.P., R. H. Mabbott.

Blackpool, St. Anne's, and Lytham Tramways Company, Ltd., Squires Gate, and 30, Birley Street, Blackpool. [T.N., 327 and 22]. *Gen. Manager and Elec. Eng.*, H. W. Laing; *Traffic Manager*, G. W. Wood; *Rolling Stock Supt.*, J. Partington; *Secretary*, Chas. E. Riding; *Chairman*, G. Nicholson; *Directors*, T. M. Smith, T. Preston.

Bray and Enniskerry Railway Company, 52, Westland Row, Dublin. *Sec.*, M. F. Keogh; *Chairman*, A. Killingley; *Director*, F. M'Crea.

Brighton Beach Electric Railway, Madeira Road, Brighton. [T.A., Volk, Brighton; T.N., 14 P.O.] *Manager and Eng.*, M. H. Volk; *Traffic Superintendent*, H. Sheppard; *Per. Way Eng.*, J. Barker; *Secretary*, A. Volk; *Chairman*, M. Volk; *Directors*, M. H. Volk, B. W. Symonds.

Bristol Tramways and Carriage Company, Ltd., Clare Street House, Bristol. [T.A., Cab, Bristol; T.N., 74 & 3074 Nat.] *Manager*, Chas. Challenger; *Assist. Manager*, S. E. Smith; *Electrical Engineer*, W. H. Munton; *Permanent Way Engineer*, G. T. C. Edwards; *Secretary*, H. F. Cooper; *Chairman*, Sir G. White, Bart.; *Directors*, W. G. Verdon Smith (*Managing*), S. White, J.P., J. H. Howell, J.P., G. Stanley White.

British Electric Traction Company, Ltd., Electrical Federation Offices, Kingsway, London, W.C. E. Garcke (*chairman*); *Directors*, C. Shirreff B. Hilton, W. L. Madgen, J. S. Raworth, G. T. Symons, C. G. Tegetmeier, P. D. Tuckett, G. Cornwallis West; *Joint Managers*, C. H. Dade and R. J. Howley; *Acting Secretary*, T. Bower; *Accountant*, C. Walmsley.

This company is interested in the following tramways, particulars of which are given under their respective names:

Airdrie & Coatbridge.
Barnsley & District.
Barrow-in-Furness.
Birmingham & District Power & Traction Co.:
Birmingham & Midland
Dudley, Stourbridge, & District.
South Staffordshire.
Wolverhampton Dist.
Devonport & District.
Gateshead & District.
General Elec. Tramways.
Gravesend & Northfleet.
Greenock & Port Glasgow.
Jarrow & District.
Kidderminster & District.
Merthyr.
Metropolitan.
Middleton.
North Staffordshire.
Oldham, Ashton, & Hyde.
Peterborough.
Potteries.
Rothesay.
Sheerness & District.
South Metropolitan.
Southport.
Swansea.
Taunton.
Tynemouth & District.
Weston-super-Mare & District.
Worcester.
Wrexham & District.
Yorkshire (Woollen Dist.)

Burton and Ashby Light Railways, Power Station, Swadlincote, nr. Burton-on-Trent. [T.A., Toulmin, Swadlincote; T.N., 1.] *Manager and Eng.*, Jas. Toulmin; *Secretary*, A. L. Charles; *Chairman*, G. Murray Smith.

[The line is owned and worked by the Midland Railway Company.]

Camborne and Redruth Tramways, Elec. Works, Carn Brea, R.S.O., Cornwall. [T.N., 3, Camborne.] (Owned by Urban Elec. Supply Co.) *Manager and Eng.*, L. A. Hards; *Sec.*, C. H. Jones; *Chairman*, P. D. Tuckett; *Directors*, E. Charrington, H. B. Grotian, Douglas Owen.

Carlisle Tramways Company, Ltd., City of, Depot and Offices, London Road, Carlisle. [T.A., Tramways, Carlisle; T.N., 0180.] *Engineer and Manager*, R. L. McCulloch.

Chatham and District Light Railways Company, Luton Road, Chatham, and 83, Cannon Street London, E.C. [T.A., Tramways, Chatham; T.N., 51.] *General Manager*, W. Jensen; *Assist. Manager*, ——— ———; *Traffic Manager*, W. G. Davis; *Secretary*, A. Clements; *Chairman*, A. R. Monks; *Directors*, H. C. Levis, J. F. Nauheim, W. B. H. Martindale.

Cheltenham and District Light Railway Company, Cheltenham. [T.N., 341.] *Directors*, A. H. Beatty (*Chairman*), W. Shearer, H. L. Williams, A. S. Guinness, H. J. McCormick; *Sec.*, Wm. C. Bryden, C. A., 66, Queen Street, London, E.C.; *Local Eng. and Manager*, Henry J. McCormick, St. George's Road, Cheltenham.

Clontarf and Hill of Howth Tramroad Company, 39, Dame Street, Dublin. [T.A., c/o Railways, Dublin; T.N., 917.] *Secretary*, J. P. Chapman; *Chairman*, W. L. Murphy; *Directors*, E. Anderson, J. J. Dudley.

Cork Electric Tramways and Lighting Company, Ltd., Albert Street, Cork. [T.A., Tramways, Cork; T.N., 78 and 535.] *Manager and Engineer*, H. H. Nalder; *Traffic Manager*, H. G. Whiting; *Per. Way Engineer*, H. Mack; *Secretary*, A. Clements; *Chairman*, A. R. Monks; *Directors*, E. Anderson, W. M. Murphy, W. B. H. Martindale, H. C. Levis.

Dartford Urban District Council Tramways, Car Depot, Priory Road, Dartford. [T.N., 31 Dartford.] (Leased to and worked by Balfour, Beatty, & Co., Ltd., 66, Queen Street, London, E.C. *Gen. Manager and Engineer*, D. N. R. Bruce.

Devonport and District Tramways Company, Tramway Depot., Milehouse, Devonport, and Electrical Federation Offices, London, W.C. [T.A., Head Office, Devonport c/o Tramway, London; T.N., Head Office, Holborn 2686. T.A., Tramways, Milehouse, Devonport; T.N., 62.] *Manager and Eng.*, George Cardwell; *Secretary*, S. M. Wright; *Chairman*, C. S. B. Hilton; *Directors*, J. S. Raworth, E. R. Soames, C. G. Tegetmeier.

Dewsbury, Batley, and Birstall Tramways Company, Ltd., Electrical Federation Offices, Kingsway, London, W.C.

[Lines worked by Yorkshire (Woollen District) Electric Tramways, Ltd., *q.v.*]

Dewsbury and Ossett Corporation and Soothill Nether Urban District Council Tramways, (Lessees: The National Elec. Construction Co., Ltd., 3, Laurence Pountney Hill, London, E.C.) [T.A., Overhauled, London; T.N., 5329 and 5330 Bank.] *Manager*, W. MacGibbon.

Douglas—Ramsey. (The Manx Elec. Rly. Company), 1, Strathallan Crescent, Douglas. (See Manx Electric Railway Company).

Douglas Southern Electric Tramways, Ltd., Marine Drive, Douglas, Isle of Man, and 24, Brazennose Street, Manchester. [T.A., Traffic, Douglas.] *Manager and Eng.*, R. Orton; *Sec.*, J. E. Sharples; *Chairman*, T. J. Hutchinson; *Directors*, I. E. Winslow, E. A. Hopkins.

Dublin and Lucan Electric Railway Company, 15, Conyngham Road, Dublin. [T.A., Lucan Tramway, Dublin; T.N. 2282 and 4006 Dublin, and 5 Lucan.] *Manager, Elec. Eng., and Sec.*, D. McDowall Grosart; *Chairman*, J. W. Hill; *Vice-Chairman*, Capt. C. C. Vesey; *Directors*, F. Anderson, H. B. Coyle.

Dublin United Tramways Company (1896), Ltd., 9, Upper Sackville Street, Dublin. [T.A., Tramways, Dublin; T.N., 58 and 59.] *Gen. Manager*, G. M. Harriss; *Elec. Eng.*, H. Tannan; *Con. Eng.*, H. F. Parshall; *Per. Way Eng.*, P. F. O'Sullivan; *Secretary*, W. McHugh; *Chairman*, W. M. Murphy; *Directors*, W. F. Cotton, Capt. C. N. Colthurst Vesey, J. Mooney.

Dudley, Stourbridge and District Electric Traction Company, Ltd. (Section of The Birmingham and Midland Tramways Joint Committee), Power Station, Downing Street, Smethwick, Brierley Hill, Staffs., and Electrical Federation Offices, Kingsway, London, W.C. [T.N., 65 Smethwick.] *General Manager*, W. G. Bond; *Secretary*, E. H. Woodhall; *Chairman*, S. R. Blundstone; *Directors*, J. A. Lycett, W. G. Bond.

Dumbarton Burgh and County Tramways Company, Tramway Depot, Dumbarton, and 23, Rutland Street, Edinburgh. [T.A., Tramways, Dumbarton; T.N., 119.] *Gen. Manager and Elec. Eng.*, J. P. McMahon; *Secretary*, J. Dishart; *Chairman*, G. Balfour; *Directors*, K. Sanderson, K. A. Scott Moncrieff.

Dundee, Broughty Ferry & District Tramways Company, Milton, Monifieth, N.B. [T.N., 24 Monifieth.] *Gen. Manager & Engineer*, Daniel Fisher; *Secretary*, E. Cowan; *Chairman*, W. Brownlee; *Directors*, Geo. Balfour, D. W. Wybrants, David Hynds.

Dunfermline and District Tramways Company, Tramway Depot, Cowdenbeath, Fife, and 8, New Row, Dunfermline. *Manager and Engineer*, J. H. Shepherd; *Secretary*, G. A. Nicolson; *Cons. Engs.*, Hawtayne & Zeden; *Directors*, Wm. Low, G. Balfour (*managing*), K. Sanderson, D. Hynd.

Falkirk & District Tramways Company, Larbert Road, Larbert, Stirlingshire. [T.A., Tramways Co., Falkirk; T.N., 154 Falkirk.] *Gen. Manager and Engineer*, D. Hays; *Chairman*, G. M. Brown; *Directors*, A. W. Tait, R. Hunter, G. Balfour, C. D. Geddes.

Felixstowe Pier Railway, Felixstowe. (The Coast Development Corporation, Ltd.) *Elec. Eng.*, E. A. Lambert.

Gateshead and District Tramways Company, Tramway Depôt, Sunderland Road, Gateshead, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramway Depôt, Gateshead; T.N., 125 & 408 Gateshead.] *General Manager*, William Morrison; *Directors*, H. A. Stagg, C. S. B. Hilton (*deputy chairman*), L. A. Atherley-Jones, K.C., H. S. Day.

Giant's Causeway and Portrush Electric Tramway Company, Portrush. *Manager & Sec.*, W. McCurdy; *Elec. Eng.*, W. A. Traill; *Chairman*, A. Traill; *Directors*, C. M'D. Stuart. J. S. Moore, W. A. Traill.

Glossop Tramways, Electricity Works, Glossop (owned by the Urban Electric Supply Co.) [T.N., 34, Glossop.] *Manager and Res. Eng.*, C. E. Knowles; *Rolling Stock Supt.*, A. W. Bullough; *Secretary*, C. H. Jones; *Chairman*, P. D. Tuckett; *Directors*, E. Charrington, F. E. Gripper, H. B. Grotrian, D. Owen.

Gosport and Fareham Tramways, Tramways and Lighting Office, Gosport, Hants., and Moorgate Station Chambers, London, E.C. [T.A., Tramways, Gosport; T.N., 3, National, Gosport, and 16, Municipal, Gosport.] *Eng. and Manager*, J. Fereday Glenn; *Sec.*, J. Barber Glenn; *Chairman*, A. Beattie, J.P., D.L.; *Directors*, J. Barber Glenn (*managing*), S. Hern.

Gravesend & Northfleet Electric Tramways, Ltd., Tramway Depot, Northfleet, Kent, and Electrical Federation Offices, Kingsway, London, W.C [T.N., 958, Gravesend.] *Manager & Sec.*, J. R. Groves; *Chairman*, W. L. Madgen; *Directors*, P. N. Gray, W. S. Wreathall.

Great Crosby Tramways, 31, James Street, Liverpool.

[This tramway is worked by the Liverpool Overhead Railway Company.]

Great Grimsby Street Tramway Co., Southampton House, Cleethorpes, and Moorgate Station Chambers, London, E.C. [T.A., Blanco, Cleethorpes; T.N., 16.] *Manager and Eng.*, H. L. White; *Elec. Eng.*, H. O. White; *Managing Director and Secretary*, J. B. Glenn; *Chairman*, A. Beattie, J.P., D.L.; *Director*, S. Hern.

Greenock and Port Glasgow Tramways Company, Ladyburn, Greenock, and Electrical Federation Offices, Kingsway, London, W.C. [T.A. Tramways, Greenock; T.N., 562]. *Manager*, A. Robertson; *Secretary*, W. F. Herring; *Chairman*, W. L. Madgen; *Directors*, G. J. Somerville, A. C. Miles, H. S. Day.

Guernsey Railway Company, Ltd., Hougue-à-la-Perre, Guernsey. *Manager and Elec. Eng.*, Arthur G. Bird; *Sec.*, J. de Mouilpied; *Chairman*, G. F. Peek; *Directors*, W. D. Murdoch, E. Valied, J. B. Collings, Q. Le Pelley.

Hampshire Light Railway (Electric) Company, Ltd., Moorgate Station Chambers, London, E.C. *Secretary*, J. B. Glenn; *Chairman*, A. Beattie, J.P.; *Directors*, J. Barber Glenn (*managing*), S. Hern.

[This company works the Portsdown and Horndean Light Railway.]

Hastings Tramways Company, Ltd., Beaufort Road, Silverhill, St. Leonards-on-Sea, and 1, Queen Victoria Street, London, E.C. [T.A., Tramways, Hastings, and Enshrine, London; T.N., 90 Hastings, and 3465, City]. *General Manager and Elec. Eng.*, W. V. Edwards; *Secretary*, W. R. Elston; *Cons. Engs.*, Kincaid, Waller, Manville, and Dawson; *Chairman*, G. Kitchen; *Directors*, E. C. Morgan, J. C. Williamson, Dr. Moody.

Imperial Tramways Company, Ltd., Clare Street House, Bristol. *Secretary*, W. G. Verdon Smith; *Manager*, F. Freshwater; *Chairman*, Sir George White, Bart.; *Directors*, H. C. Godfray, J. H. Howell, S. White.

Isle of Thanet Electric Tramways and Lighting Company, Ltd., St. Peter's, Kent, and Moorgate Station Chambers, London, E.C. [T.A., Tramways, St. Peters, Kent; T.N., 29 Broadstairs]. *Gen. Manager and Elec. Eng.*, J. A. Forde; *Traffic Supt.*, A. L. Gardener; *Secretary*, J. Barber Glenn; *Chairman*, A. R. Monks; *Directors*, Lord Arthur Butler, W. M. Murphy, H. Brown.

Jarrow and District Electric Traction Company, Ltd., Electrical Federation Offices, Kingsway, London, W.C. [T.A., Jarrow, c/o Tramway, London; T.N., 2686 Holborn.] *Traffic Manager*, G. McClelland; *Secretary*, C. W. Francis; *Chairman*, G. J. Somerville; *Directors*, W. Morrison (*managing*), H. S. Day.

Kidderminster & District Electric Lighting and Traction Co., Ltd., Kidderminster and Electrical Federation Offices, Kingsway, London, W.C. [T.N., 108]. *Managing Eng.*, A. Wray *Secretary*, B. Kingsford; *Chairman*, C. S. B. Hilton; *Directors*, J. A. Lycett (*managing*), S. E. Garcke H. S. Day.

Kinver Tramway, Kinver, and Electrical Federation Offices, Kingsway, London, W.C., *q.v.*, Dudley, Stourbridge, and District Elec. Traction Co., Ltd.

Lanarkshire Tramways Company, Edinburgh Road, Motherwell, N.B., and 83, Cannon Street, London, E.C. [T.A., Tramways, Motherwell; T.N., 64.] *Gen. Manager and Eng.*, G. F. Moller; *Elec. Eng.*, E. H. Glennie; *Per. Way Eng.*, R. Foster; *Traffic Supt.*, J. L. White; *Sec.*, A. Clements; *Chairman*, A. R. Monks; *Directors*, Sir B. Cunard, H. C. Levis, W. H. Whaite, G. Franklin, J. F. Nauheim.

Lancashire United Tramways Limited, Atherton, Lancs. [T.A., Tramways, Atherton; T.N., 36, Atherton.] *Gen. Manager*, E. H. Edwardes; *Secretary*, H. P. Conibear; *Chairman*, Hon. A. Stanley, M.P.; *Directors*, J. M. Henderson, M.P., Sir J. Beecham, J.P., R. Watson, J.P., A. Adam, J. S. Austen.

Liverpool and Prescot Light Railway.—This line, which with the St. Helens Tramways forms the connecting link between the City of Liverpool and South Lancashire Tramways, is owned and worked by the Lancashire United Tramways, Ltd.

Liverpool Overhead Railway Company, 31, James Street, Liverpool. [T.A., Motor, Liverpool; T.N., 5463 Central.] *Gen. Manager and Eng.*, E. J. Neachell; *Secretary*, W. H. Alexander; *Chairman*, H. C. Woodward; *Directors*, J. E. Anderson, G. D. Killey J. U. Hodgson, M. H. Maxwell.

Llandudno and Colwyn Bay Electric Railway, Limited, Tramway Depôt, Rhôs-on-Sea, Colwyn Bay, and Basildon House, Moorgate Street, London, E.C. *Gen. Manager*, Alex. G. Balfour; *Secretary*, A. W. R. Lovering; *Directors*, G. Balfour, A. W. Tait, T. Stoker.

London United Tramways Ltd., Electric Railway House, Broadway, Westminster, London, S.W. [T.N., 6800, Victoria.] *Managing Director*, J. Devonshire; *Secretary*, A. L. Barber; *Gen. Manager and Eng.*, A. H. Pott; *Chairman*, W. M. Acworth; *Directors*, Rt. Hon. Viscount Knutsford, Sir A. H. Stanley, F. V. Schuster.

Luton Corporation Tramways (leased to and worked by Balfour, Beatty & Co., Ltd., 22a, College Hill, London, E.C.), Tramway Offices, Park Street, Luton. [T.N., 230.] *Engineer and Manager*, A. E. Wray.

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ELECTRIC TRAMWAYS IN THE UNITED KINGDOM.

Mansfield & District Light Railway Co., Sutton Road, Mansfield. [T.A., Cars, Mansfield; T.N., 107.] *Gen. Manager and Sec.*, C. R. Walker; *Chairman*, A. R. Holland; *Directors*, W. I. Chadburn A. H. Beatty, G. Balfour.

Manx Electric Railway Company, Ltd., 1, Strathalian Crescent, Douglas, Isle of Man, and 3, Finch Lane, London, E.C. [T.A., Electric, Douglas, Man.; T.N., 61.] *Gen. Manager & Eng.*, F. Edmondson; *Secretary*, C. A. Huni; *Chairman*, Col. Sir A. Griffith Boscawen; *Directors*, Sir W. H. Vaudrey, B. E. Greenwell, E. Schenk.

Merthyr Electric Traction and Lighting Company, Ltd., 53, Pontmorlais Circus, Merthyr, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramway Company, Merthyr; T.N., 0180, Merthyr Tydfil.] *Managing Eng.*, L. W. Dixon; *Traffic Supt.*, H. King; *Sec.*, S. J. Clements, *Chairman*, G. J. Somerville; *Directors*, C. G. Tegetmeier, W. L. Madgen, E. R. Soames.

Metropolitan Electric Tramways, Limited, Electric Railway House, Broadway, Westminster, London, S W. [T.A., Metrolito, London; T.N., 6800, Victoria.] Manor House Offices, Seven Sisters Road, N. [T.A., Lentiscus, London; T.N., 77 Tottenham.] *Gen. Manager and Eng.*, A. H. Pott; *Traffic Manager*, W. E. Hammond; *Secretary*, A. L. Barber; *Chairman*, E. Garcke; *Directors*, Sir E. Spencer, W. L. Madgen, C. G. Tegetmeier, J. Devonshire (*Managing Director*).

Mexborough and Swinton Tramways Company, Electricity Works, Rawmarsh, Yorks. [T.N., 266], and 3, Laurence Pountney Hill, Cannon Street, London, E.C. *Manager and Eng.*, P. Priestly; *Cons. Elec. Eng.*, F. E. Stanley; *Commercial Manager*, Wm. T. Mitchell; *Traffic Supt.*, M. McLeod; *Secretary*, L. D. H. Jacobs; *Chairman*, L. B. Schlesinger; *Director* (*Managing*), W. B. Cownie, C.A.

Middlesbro, Stockton, and Thornaby Electric Tramway, Bridge Road, Stockton-on-Tees, and Clare Street House, Bristol. [T.A., Tramways, Stockton; T.N., 129.] *Manager*, F. Freshwater; *Secretary*, W. G. Verdon Smith; *Chairman*, Sir Geo. White, Bart.; *Directors*, H. C. Godfray, S. White, H. C. Doggett.

Middleton Electric Traction Company, Hiltonfold Lane, Middleton, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramway Depot, Middleton; T.N., 37 Middleton.] *Gen. Manager*, W. F. Endean; *Secretary*, W. E. Woodroofe; *Chairman*, Lord Vaux of Harrowden; *Directors*, J. V. Kitchener, W. S. Wreathall.

Musselburgh and District Electric Light and Traction Co., Ltd., High St., Musselburgh, N.B. [T.A., Tramways, Musselburgh; T.N., 115.] (Registered Office, 3, Laurence Pountney Hill, London, E.C. [T.N., 5329 and 5330, Bank.]) *Manager*, R. Watson; *Resident Engineer*, J. L. Winter; *Traffic Inspector*, W. Scott; *Secretary*, L. D. H. Jacobs; *Chairman*, L. B. Schlesinger; *Directors*, B. Bernheim, J. Anderson, W. B. Cownie, Dr. K. Lowenfeld.

New General Traction Company, Ltd., 8, Crosby Square, London, E.C. *Managing Director*, E. A. Hopkins; *Secretary*, J. G. Mills; *Chief Engineer*, I. E. Winslow; *Chairman*, Baron E. B. d'Erlanger. [This company controls the Norwich and the Douglas Southern Electric Tramways Companies.]

New St. Helens and District Tramways Company, Ltd., Atherton, Lancs. [T.A., Tramways, Atherton; T.N., 36 Atherton.] *Engineer and Manager*, C. D. Stanley; *Secretary*, H. P. Conibear; *Chairman*, Hon. Arthur Stanley, M.P.; *Directors*, J. Hunter, J.P., H. Martin, J.P., J. M. Henderson, M.P., J. S. Austen, and E. H. Edwardes (*Managing*).

North Shields Tramway Company owned and worked by Tynemouth and District Elec. Trac. Co. *q.v.*

Norwich Electric Tramway Company, 5, Orford Hill, Norwich, and 8, Crosby Square, London, E.C. [T.A., Tramways, Norwich; T.N., 475.] *Manager and Engineer*, F. W. Ketley; *Consulting Eng.*, I. E. Winslow; *Sec.*, J. G. Mills; *Chairman*, Baron E. B. d'Erlanger; *Directors*, E. A. Hopkins, Hon. A. G. Brand, F. FitzGerald, G. M. Chamberlin.

Nottinghamshire and Derbyshire Tramways Company, Tramway Depot, Langley Mill, Derbyshire, and 66, Queen Street, London, E.C. [T.A., Tramways, Langley Mill; T.N., 53, Langley Mill.] *Manager*, C. R. Walker; *Secretary*, Wm C. Bryden; *Directors*, A. R. Holland, A. H. Beatty, A. V. Anderson, and M. A. Edwards.

Oldham, Ashton and Hyde Electric Tramway, Ltd., Tramway Depot, Denton, Lancs., and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramways, Denton; T.N., 265 Ashton.] *Supt.*, A. Anderson; *Secretary*, W. E. Woodroofe; *Chairman*, E. Garcke; *Directors*, L. A. Atherley Jones, K.C., R. Whittaker, W. S. Wreathall, J. V. Kitchener (*Managing Director.*)

Paisley District Tramways Company, Tramway Depôt, Paisley, and 83, Cannon Street, London, E.C. [T.N., 218 Paisley.] *Gen. Manager and Elec. Eng.*, Fred Coutts; *Traffic Supt.*, E. Jeffs; *Secretary*, A. Clements; *Con. Eng.*, H. F. Parshall; *Chairman*, O. H. Smith; *Directors*, Lord Arthur Butler, D. Johnston Smith, John Young.

Peterborough Electric Traction Company, Ltd., Lincoln Road, Peterborough, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramways, Peterborough; T.N., 224.] *Gen. Manager*, T. G. Clabburn; *Secretary*, S. M. Wright; *Chairman*, Lord Vaux of Harrowden; *Director*, E. A. Paris.

Plymouth, Stonehouse and Devonport Tramways Co., 16, Edgcumbe Street, Stonehouse, Devon, and Moorgate Station Chambers, London, E.C. [T.N. 53.] *Manager*, G. H. Moreton; *Elec. Eng.*, J. Graham Pearce; *Sec.*, J. Barber Glenn: *Chairman*, Andrew Beattie, J.P., D.L.; *Directors*, S. Hern, J. B. Glenn (*Managing*).

Portsdown and Horndean Light Railway, Cosham, Hants.; Tramways and Lighting Office, Gosport, Hants., and Moorgate Station Chambers, London, E.C. [T.A., Tramways, Gosport; T.N., Municipal 16 and Nat. 3, Gosport.] *Engineer and Manager*, J. Fereday Glenn; *Secretary*, J. Barber Glenn; *Chairman*, A. Beattie, J.P., D.L.; *Directors*, J. Barber Glenn (*Managing*), S. Hern.

Potteries Electric Traction Company, Tramway Depôt, Stoke-on-Trent, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramways, Stoke-on-Trent; T.N., 801.] *Gen. Manager and Eng.*, W. Thom; *Power and Rolling Stock Supt.*, F. J. Chapple; *Traffic Manager*, F. Hatch; *Secretary*, W. F. Herring; *Chairman*, G. Cornwallis-West; *Directors*, F. W. Chanter, S. Mear, J. V. Kitchener.

Rhondda Tramways Company, Ltd., Tramway Depôt, Porth, Rhondda, and Laurence Pountney Hill, Cannon Street, London, E.C. [T.A., Tramway, Porth; T.N., 8.] *Manager and Engineer*, H. Holliday; *Secretary*, L. D. H. Jacobs; *Chairman*, L. B. Schlesinger; *Directors*, J. C. Saunders, W. B. Cownie, J. T. Jervis, H. T. Barnett.

Rothesay Tramways Company, Ltd., Point House, Rothesay, and Electrical Federation Offices, Kingsway, London, W.C. *Manager*, A. Robertson; *Elec. Eng.*, H. H. Hill; *Sec.*, W. F. Herring; *Chairman*, A. C. Miles; *Directors*, W. L. Madgen, H. S. Day.

Ryde Pier Company, Ryde, Isle of Wight. *Manager*, W. D. Stanney; *Elec. Eng.*, C. Harrison; *Chairman*, G. E. Mears.

Scarborough Tramways Company, Scalby Road, Scarborough. [T.A., Electric Tramways, Scarborough; T.N., 294.] *Gen. Manager and Elec. Eng.*, J. V. Moinet; *Chairman*, F. E. Gripper; *Directors*, V. Fowler, M. T. Whittaker, J. C. Wigham.

Sheerness and District Electric Power and Traction Company, Ltd., Electricity Works, Sheerness East, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramways, Sheerness; T.N., 45.] *Manager & Eng.*, C. W. Durnford; *Sec.*, P. N. Gray; *Chairman*, G. J. Somerville; *Directors*, R. J. Howley, E. R. Soames.

Snaefell Mountain Railway (See Manx Electric Railway Company).

South Metropolitan Electric Tramways and Lighting Company, Ltd., 114, Church Street, Croydon, 30, High Street, Sutton, and Electric Railway House, Broadway, Westminster, London, S.W. [T.N., 304 Croydon, 14 Sutton and 6800, Victoria.] *Gen. Manager and Engineer*, A. V. Mason; *Supt.*, A. E. Wray; *Secretary*, W. M. Wright; *Chairman*, C. G. Tegetmeier; *Directors*, J. Devonshire, E. Garcke.

Southport Pier Co., Ltd., Southport. [T.A., Pier, Southport; T.N., 174.] *Manager*, W. H. Scott; *Chairman*, A. Skinner; *Directors*, J. R. Haworth, S. J. Fane, G. Duckworth, J. Duckworth.

Southport Tramways Company, Ltd., The Depôt, Churchtown, Southport, and Electrical Federation Offices, Kingsway, London, W.C. *Manager*, J. Lloyd; *Secretary*, H. A. Stagg; *Chairman*, C. S. Hilton; *Directors*, J. S. Haworth, Lord Vaux of Harrowden, J. V. Kitchener.

South Staffordshire Tramways (Lessee) Company, Ltd., Power Station, Downing Street, Smethwick, and Electrical Federation Offices, Kingsway, London, W.C. [T.N., 65 Smethwick.] *General Manager*, W. G. Bond; *Secretary*, E. H. Woodhall; *Chairman*, W. S. Schuster; *Directors*, J. A. Lycett, S. R. Blundstone, W. G. Bond, B. Kingsford.

Sunderland District Electric Tramways, Ltd., Fence Houses, co. Durham. [T.A., Trams, Philadelphia, Shiney Row; T.N., 21, Houghton-le-Spring.] *Resident Manager and Engineer*, G. Stratton; *Traffic Manager*, E. A. Pearman; *Secretary*, H. J. Almond; *Directors*, H. R. Hogg, Hon. R. Parker, R. Tayler.

Sutton and Howth Electric Tramway Company (owned by the Great Northern Railway, Ireland), Sutton, county Dublin, and Amiens Street Terminus, Dublin. [T.A., Railroad, Dublin; T.N., 171, Dublin and 16 Sutton.] *Gen. Manager*, John Bagwell; *Elec. Eng.*, A. W. Whieldon; *Supt. of Line*, R. J. Moore; *Chief Eng.* F. A. Campion; *Locomotive Supt.*, G. T. Glover; *Sec.*, T. Morrison; *Chairman*, F. Vernon; *Directors*, W. P. Cairnes (*Deputy Chairman*), Sir W. Q. Ewart, Bart., W. B. Carson, H. S. Guinness, J. T. Reade, W. L. A. Goulding, Major J. C. W. Madden, R. A. Gradwell, J. Milne Barbour, T. F. Cooke, W. H. B. Moorhead, Lt.-Col. H. Plews.

Swansea Improvements and Tramways Company, 2, Rutland St., Swansea, and Electrical Federation Offices. Kingsway, London, W.C. [T.A., Tramway, Swansea; T.N., 268 Swansea.] *Gen. Manager*, D. James; *Elec. Eng.*, A. Johnston; *Secretary*, S. J. Clements; *Chairman*, C. G. Tegetmeier; *Directors*, G. J. Somerville, S. E. Garcke.

Taunton Electric Traction Company, Ltd., East Reach, Taunton, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Taunton, c/o "Tramways," London.] *Manager*, B. H. Griffith; *Secretary*, S. M. Wright; *Chairman*, G. J. Somerville; *Directors*, E. Garcke.

Torquay Tramways Co., Ltd., St. Marychurch Road, Torquay. [T.A., Carsheds, Torquay; T.N., 167 Torquay.] *Registered Office*, 3, Laurence Pountney Hill, Cannon Street, E.C. *Manager and Eng.*, H. J. Nisbett; *Secretary*, L. D. H. Jacobs; *Managing Director*, W. B. Cownie.

Trafford Park Company (Tramways), Trafford Park, Manchester. [T.A., Developing, Manchester; T.N., 61, Trafford Park.] *Secretary*, C. A. Grundy; *Chairman*, Marshall Stevens; *Directors*, Sir J. Lyons, H. McNiel.

[Lines worked by the Manchester and Salford Corporations.]

Tynemouth and District Electric Traction Company, Limited, John Street, Cullercoats, Northumberland, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tram Co., Cullercoats; T.N., 17 Whitley.] *Gen. Manager*, H. J. Smith; *Sec.*, C. W. Francis; *Chairman*, H. S. Day; *Directors*, J. H. Robinson, J. B. Williamson, R. J. Howley Geo. J. Somerville.

Tyneside Tramways and Tramroad Company, Ltd., Neptune Bank, Wallsend. [T.A., Tramways, Wallsend; T.N., 84.] *Secretary & Res. Manager*, J. C. Little; *Elec. Eng.*, F. H. Briggs; *Cons. Eng.*, W. McLellan; *Chairman*, J. T. Merz; *Directors*, Lord Armstrong, J. H. Armstrong, G. E. Henderson, S. Hunter.

Wakefield and District Light Railway Company, Belle Isle, Wakefield.

[This company has been amalgamated with the Yorkshire (West Riding) Electric Tramways Co., Ltd.]

Walton-on-the-Naze Pier Tramway (Coast Development Corporation, Ltd.), The Pier, Walton-on-the-Naze. [T.A., Electricity Works, Walton-on-Naze.] *Eng.*, E. A. Lambert, A.M.I.E.E.; *Sec.*, J. F. Stovell; *Chairman*, —Hallett; *Directors*, Sir T. Sturmey Cave P. Denny, G. Mitchell, G. Riley, H. R. Spence (*Managing*).

Wemyss and District Tramways Company, Ltd., Car Depot, Aberhill, Methill, N.B. [T.A., Tramways, Methill; T.N., 38 Leven.] *Gen. Manager*, W. T. Dawson; *Sec.*, J. O. Shepherd; *Chairman*, G. Balfour; *Directors*, W. Shepherd, G. Balfour, J. H. Guild.

Weston-super-Mare and District Electric Supply Co., Ltd., Locking Road, Weston-super-Mare, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramways, Weston-s.-Mare; T.N., 79 & 181.] *Manager and Elec. Eng.*, G. Charlton; *Sec.*, H. A. Stagg; *Chairman*, G. J. Somerville; *Directors*, C. G. Tegetmeier, E. R. Soames.

Wolverhampton District Electric Tramways, Limited, Tramway Depot, Bilston, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramways, Bilston; T.N., 56, Bilston.] *General Manager*, W. G. Bond; *Sec.*, C. H. Woodhall; *Chairman*, S. R. Blundstone; *Directors*, J. A. Lycett, W. G. Bond, B. Kingsford.

Worcester Electric Traction Company, Ltd., St. John's, Worcester, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramways, Worcester; T.N., 81.] *Engineering Manager*, R. Simpson; *Secretary*, C. W. Francis; *Chairman*, H. S. Day; *Directors*, J. A. Lycett, C. S. B. Hilton, S. E. Garcke.

Wrexham and District Electric Tramways Limited, 6, Lord Street, Wrexham, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramways, Wrexham; T.N., 182, Wrexham.] *Manager*, A. A. Hawkins; *Sec.*, W. E. Bennett; *Chairman*, J. V. Kitchener; *Directors*, G. J. Somerville, W. S. Wreathall.

Yorkshire (West Riding) Electric Tramways Co., Ltd., Belle Isle, Wakefield. [T.A., England, Belle Isle, Wakefield; T.N., 218.] *Gen. Manager and Sec.*, H. England: *Elec. Engs.*, C. J. Jewell and E. A. Wood; *Traffic Supt.*, W. Wilde; *Chairman*, Sir Herbert S. Leon, Bart.; *Directors*, E. Schenk, B. Newgass, G. E. Leon.

Yorkshire (Woollen District) Electric Tramways, Limited, Frost Hill, Liversedge, and Electrical Federation Offices, Kingsway, London, W.C. [T.A., Tramways, Heckmondwike; T.N., 8 Heckmondwike.] *Secretary*, P. N. Gray; *Chairman*, E. Garcke; *Directors*, Sir Thos. Pilkington, E. A. Paris (*managing*).

TRAMWAY ASSOCIATIONS.

MUNICIPAL TRAMWAYS ASSOCIATION.

President:
PETER FISHER
(General Manager, Dundee Corporation Tramways).

Vice-President:
HENRY MOZLEY
(General Manager, Burnley Corporation Tramways).

Hon. Secretary and Treasurer:
C. J. SPENCER
(General Manager, Bradford Corporation Tramways), 7, Hall Ings, Bradford.

TRAMWAYS AND LIGHT RAILWAYS ASSOCIATION.

President:
The Rt. Hon. VISCOUNT CHILSTON.

Chairman:
The Hon. ARTHUR STANLEY, M.P.

Vice-Chairman:
HARRY ENGLAND.

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Hon. Auditor: A. W. CHAMBERS, A.S.A.A.

Secretary:
A. DE TURCKHEIM.

Offices: Caxton House, Westminster, London, S.W. Telephone No. 2110 Victoria.

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LIST OF ELECTRIC TRAMWAYS & RAILWAYS.

PARTICULARS OF TRACK AND EQUIPMENT.

TRAMWAYS, pp. xxvii-xxx. RAILWAYS, p. xxx.

Location of Line and Name of Operating Company.	Date of Opening of First Section.	Length of Route.	Total length of Track.	Gauge.	Weight and Type of Rail.	Maximum Gradient.	Sharpest Curve.	No of Motor Cars.	No of Dynamos	No. of Engines	Type of Engines	Total Capacity Traction, KW.	Principal Contractors for Electrical Equipment
TRAMWAYS.				ft. in.	lbs.	1 in	ft. rad.						
Aberdare Urban District Trys. ..	Oct., 1913	2·9	3·3	3 6	96 G	13	45	10	2	2	V.Cp.C.	400	Lanc. Dynamo Co.
Aberdeen Corporation	Dec., 1899	14·4	27·75	4 8½	96 G	13	42·5	83	*14	14	V.Cp.C.	4,610	Macartney, McElroy & Co.
Aberdeen Suburban Trys. Co. ..	June, 1905	5	5	4 8½	95 G	28	90	9	..	..	..	..	J. G. White & Co. Brush Co.
Accrington Corporation	Aug., 1907	7	10·66	4 0	95 G	14	..	27	*8	8	..	1,888	Brush Co.
Airdrie & Coatbridge Tramway Co.	Feb., 1904	3·63	4·94	4 8½	94 G	14	210	15	..	..	..	..	Brush Co.
Ashton-under-Lyne Corporation ..	Aug., 1902	7	8·15	4 8½	96 G	10	40	25	5	5	..	400	Dick, Kerr, & Co Siemens Bros.
Ayr Corporation	Sept., 1901	6	7·612	4 8½	90 G	21	45	22	*8	8	..	400	British T-H.
Barking Town Urban District ..	Dec., 1903	2·6	3·125	4 8½	100 G	25	44	9	4	3	V.Cp.C.	..	Blackwell & Co.
Barnsley & Dist. Elec. Traction Co.	Nov., 1902	3·06	4·25	4 8½	97 G	10	60	13	*6	6	..	..	J. G. White & Co. Brush Co.
Barrow-in-Furness	Feb., 1904	5·37	8·25	4 0	90 G	13	50	16	*8	..	..	..	Brush Co. Dick, Kerr, & Co
Bath Electric Tramways, Ltd. ..	Jan., 1904	14·7	19·3	4 8½	95 G	10·7	38	40	4	4	H.T.Cp.	675	Westinghouse
Batley Corporation	Oct., 1903	6·536	10·47	4 8½	104 G	9	40	15	4	4	..	..	B. I. W. Co. British Elc.Cr.Co
Belfast City	Dec., 1905	49·65	98·54	4 8½	105 G	15	35	290	3	3	Tri.Exp.	3,000	J. G. White & Co. Westinghouse
Bessbrook—Newry (1) .. .. Bessbrook and Newry Try. Co.	Oct., 1885	3	3	3 0	41 V	80	55	2	2	1	Hyd.Turb.	..	Mather & Platt
Bexley Urban District	Oct., 1903	5·25	6·5	4 8½	90 G	14	40	16	2	2	V. Cp.	..	Dick, Kerr, & Co.
Birkenhead Corporation	Feb., 1901	13·8	24·09	4 8½	100 G	13½	40	65	6	6	V. Cp.	..	Blackwell & Co. British T-H.
Birmingham Corporation	Jan., 1904	65·56	114·55	3 6	105 G	13	40	550	..	..	..	1,475	Dick, Kerr, & Co.
Birmingham and Midland Trys. Co.	July, 1904	12·20	18·8	3 6	85 & 94 G	15	31	62	6	6	Cp.	..	Brush Co.
Blackburn Corporation	March, 1899	14·67	24·75	4 0	92 G	15	30	61	*4	4	V.Cp.C.	..	British T-H. Blackwell & Co.
Blackpool Corporation	Oct., 1885	14·75	21·38	4 8½	96 G	20	36	78	..	..	Stm.Turb.	600	Elwell-Parker British T-H.
Blackpool & Fleetwood Tramrd. Co.	July, 1898	7·9	15	4 8½	56&70V 98G	26	80	37	5	5	V. Cp.	600	Mather & Platt Dick, Kerr, & Co
Blackpool and Fylde Light Ry. Co.	Under cons.	14	14·5	4 8½	..	..	..	..	..	..	..	..	
Blackpool—St. Anne's & Lytham ..	May, 1903	7·47	14·03	4 8½	92 G	22	35	40	..	..	..	..	British T-H.
Bolton Corporation	Nov., 1899	26	47·21	4 8½	90G	14	35	112	*12	12	V.Cp.C.	3,800	Dick, Kerr, & Co Blackwell & Co.
Bootle Corporation	May, 1900	4·125	7·75	4 8½	95 G	20	40	55	8	8	..	..	Blackwell & Co.
Bournemouth Corporation	July, 1902	22	29·77	3 6	100 G 66 slot	10	40	81	4	4	Cp.	1,500	J. G. White & Co.
Bradford Corporation	July, 1898	54·8	103·86	4 0	102 G	9·8	40	248	11	11	V.Cp.C	..	Westinghouse Blackwell & Co.
Bray and Enniskerry Railway Co.	Under cons.	3·25	5	3 6	..	..	..	..	..	..	..	..	
Brighton Corporation	Nov., 1901	9·48	17·18	3 6	101 G	9	40	53	5	5	Stm.Turb.	1,000	Macartney & Co. Westinghouse Blackwell & Co.
Brighton Beach (1)	Aug., 1883	1·75	2	2 8½	35 V	100	80	8	2	1	Gas	..	Siemens Bros.
Bristol—Bristol Trys. Co	Oct., 1895	31	57·5	4 8½	92½G	10	30	232	6	4	V.Cp.C.	..	British T-H. and Blackwell & Co.
Burnley Corporation	Dec., 1901	11·9	22·16	4 0	102 & 107 G	9·8	35	67	*8	8	H.Cp.C.	750	British T-H.
Burton and Ashby Light Railway..	July, 1906	10·2	12·3	3 6	90 G	11	51	20	2	2	Diesel	330	Dick, Kerr & Co. Brush Co.
Burton-on-Trent Corporation ..	Aug., 1903	6·67	9·75	3 6	90 G	11·7	40	20	4	3	V. Cp.	400	Dick, Kerr, & Co. Blackwell & Co.
Bury Corporation	June, 1903	22·5	34·42	4 8½	102¾ G	12	40	54	6	6	..	1,500	Westinghouse
Camborne and Redruth	Nov., 1902	3·75	4	3 6	83 G	15	40	8	7	7	Cp.	1,525	Dick, Kerr, & Co. British T-H.
Cardiff Corporation	May, 1902	17·25	31·82	4 8½	100 G	23	35	130	9	9	V.Cp.C.	2,200	British T-H. Dick, Kerr, & Co.
Carlisle, City of, Elec. Try. Co. ..	June, 1900	7·25	8·5	3 6	83 G	14	23	15	4	4	..	..	Dick, Kerr, & Co.
Cavehill & Whitewell Try. Co...	Feb., 1906	3·29	4·31	4 9	105 G	31	75	10	..	..	..	..	J. G. White & Co.
Chatham & District Light Rly. Co.	June, 1902	14·98	26	3 6	92½ & 105 G	9	35	50	5	4	H. Cp.	675	British T-H. Co Brush Co.
Cheltenham and District ..	Aug., 1901	10·22	12·25	3 6	80 & 90 G	8·9	37	20	2	2	V.Cp.	..	Westinghouse
Chester Corporation..	April, 1903	3·51	6·3	3 6	94&100G	30	40	18	*7	7	V.Cp.C.	240	Blackwell & Co. British T-H.
Chesterfield Corporation	Dec., 1904	3·6	5·1	4 8½	96 & 101 G	20	40	17	4	4	V.Cp.C.	800	Milnes & Co. Westinghouse Brush
Clontarf and Hill of Howth ..	July, 1900	5·5	6·5	5 3	90 & 60 G	13	34	12	..	..	..	..	W.M. Murphy & Co.
Colchester Corporation	July, 1904	6	7·94	3 6	95 G	12	43	18	8	8	V. Cp.	1,140	Dick, Kerr & Co. J. G. White & Co.
Colne Corporation Tramways ..	Nov., 1903	5·2	6·7	4 0	102 G	13	60	12	*	..	..	..	Blackwell & Co. Glover & Co.
Cork Elec. Try. & Lighting Co. ..	Dec., 1898	10	15	2 11½	83 G	14	26	35	*9	9	H.Cp.C.	1,450	British T-H. Blackwell & Co.
Coventry Corporation Tramways..	Dec., 1895	13·25	15·40	3 6	65 G 81 G	16	35	46	5	5	H.&V.Cp.	700	Westinghouse Blackwell & Co.
Croydon Corporation	Sept., 1901	11	19·12	4 8½	96·5 G	16	40	75	*13	13	..	2,000	British T-H. Co.
Darlington Corporation	June, 1904	4·875	8·88	3 6	90 G	14	46	18	9	7	..	..	Westinghouse

* Current from combined lighting and traction station. (1) Third rail system. † Includes 1·25 miles railless trolley line.

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ELECTRIC TRAMWAYS & RAILWAYS.—Particulars of Track and Equipment.

Location of Line and Name of Operating Company.	Date of Opening of First Section.	Length of Route.	Total Length of Track.	Gauge.	Weight and Type of Rail.	Maximum Gradient.	Sharpest Curve.	No. of Motor Cars	No. of Dynamos	No. of Engines	Type of Engines.	Total Capacity Traction, kw.	Principal Contractors for Electrical Equipment.
TRAMWAYS—*continued.*				ft. in.	lbs.	1 in	ft. rad.						
Dartford U. D. C.	Feb., 1906	6·5	8·5	4 8½	100 G	12	35	12	4	..	..	..	British I. W.
Darwen Corporation	Oct., 1900	4·36	7·16	4 0	95 G	9	35	17	*4	4	H. Cp.	..	British T-H.
Derby and Ashbourne	..	14·5	..	4 8½									J. G. White & Co.
Derby Corporation	July, 1904	13	22·06	4 0	95 G	14	46	50	3	3	Stm.Turb.	..	Brush Co.
Devonport & District Try. Co., Ltd.	June, 1901	8·85	15·79	3 6	92 G	11	35	25	*	..	..	..	Blackwell & Co.
Devonport Corporation	June, 1901	..	7	3 6	97 G	10	50	12	..	..	..	..	Blackwell & Co.
Doncaster Corporation	June, 1902	8·25	12·52	4 8½	94 G	16	45	32	8	8	..	1,000	Blackwell & Co.
Dover Corporation	Sept., 1897	4·75	7	3 6	87 & 90 G	10	44	21	*2	2	H.CC.	..	Dick, Kerr, & Co.
Douglas—Port Soderick .. Douglas Southern Elec. Trys. Co.	Aug., 1896	3·25	3·75	4 8½	65 V	12	45	8	2	2	H. Cp.	200	Westinghouse British T-H.
Dublin & Lucan Elec. Railway Co.	March, 1900	6·5	7	3 6	50 V	20	27	16	2	2	H. Cp.C.	240	Dick, Kerr, & Co
Dublin United Tramways Co.	May, 1896	49·8	95·26	5 3	105 G	12·3	22	365	8	7	V. Cp. C.	4,300	Dick, Kerr, & Co Blackwell & Co. British T-H.
Dudley and Stourbridge Trys. British Electric Traction Co.	July, 1899	21·25	27·25	3 6	90 G	11	50	59	4	4	H. Cp.	..	British T-H. Blackwell & Co.
Dumbarton	Feb., 1907	13	17	4 7¾	90 & 96	14	60	26	3	3	..	..	Dick, Kerr, & Co.
Dundalk	Under cons.	6	6·25	3 6	97 G	10	50	12					J. G. White & Co.
Dundee, Broughty Ferry, and District	Dec., 1905	5	9·125	4 8½	90 G	16·5	30½	14	3	3	V. Cp. C.	..	J. G. White & Co. British T-H. Co.
Dundee Corporation	July, 1900	15·5	27·47	4 8½	90 & 100 G	10	35	68	5	5	..	..	Blackwell & Co.
Dunfermline (Fife Try. & Power Co.)	Nov., 1909	14·6	17·4	..	90 G	10	25	28	2	2	..	..	
East Ham Corporation	June, 1901	7·26	14·34	4 8½	90 & 105 G	25	40	45	5	5	H. Cp.	500	Dick, Kerr, & Co.
Eccles Corporation	May, 1902	5	7·75	4 8½	100 G	..	..	..	..	..	..	..	
Edinburgh and District	June, 1910	1·25	1·5	4 8½	100 G	21	54	4	..	..	..	..	Dick, Kerr, & Co.
Erith Urban District Council	Aug., 1905	4·7	8·4	4 8½	100 G	17	40	17	3	5	..	..	Brush Co. Westinghouse Co.
Exeter Corporation	April, 1905	4·875	7	3 6	90 G	11·5	35	20	*4	4	H. Cp.	..	Dick, Kerr, & Co.
Falkirk and District	Oct. 1905	7·81	10·5	4 0	90 G.	11·3	48	18	*	..	..	..	Bruce Peebles & Co.
Farnworth Urban District	Jan., 1902	4·33	7·16	4 8½	98 G	29	36	13	4	4	..	..	
Felixstowe Pier	Aug., 1905	0·5	0·5	3 6	36	..	..	3	..	..	..	..	
Gateshead and District	May, 1901	11·25	17·30	4 8½	90 G	8	35	53	*	..	..	..	Dick, Kerr, & Co. Blackwell & Co.
Giant's Causeway Elec. Try. Co.	Sept., 1883	8	9	3 0	42 V 75 G	24	30	26	2	2	Hyd.Turb.	..	Siemens Bros. British T-H.
Glasgow Corporation	Oct., 1898	98·18	196·23	4 7¾	110 G	11·93	30¾	856	7	7	V. Cp.	14,200	British T-H. Westinghouse
Glossop Urban District	Aug., 1903	4·56	5·6	4 8½	90 G	13	40	8	4	4	V. Cp.	200	British T-H.
Gloucester Corporation Light Rly.	May, 1904	9	15	3 6	90 G	25	40	30	*2	2	Cp.	750	Brush Co. Dick, Kerr, & Co
Gosport & Fareham Trys. Co.	Jan., 1906	7·5	11·5	4 7¾	96 G	16	37½	22	3	3	V. Cp. C.	750	Dick, Kerr, & Co.
Gravesend and Northfleet	Aug., 1902	6·5	9	4 8½	87 G	11	45	18	*				Brush Co.
Great Crosby	June, 1900	2·5	2·5	4 8½	92½ G	..	40	14	*7	7	H. & V. Cp.	160	Dick, Kerr, & Co. Blackwell & Co.
Great Grimsby	Dec., 1901	6	11	4 8½	90 G	15	26	38	2	2	..	300	Dick, Kerr, & Co.
Greenock and Port Glasgow	Oct., 1901	7·425	14·05	4 7¾	90 G	11	60	42	*				
Guernsey Railway Co.	Nov., 1892	3	3	3 8½	40 & 74 V 84 G	60	60	18	2	2	H. & V. Cp.	160	Siemens Bros. British T-H.
Halifax Corporation	June, 1898	37·4	54·88	3 6	95½ G	9·5	38·6	101	*9	9	H. & V. Cp.	2,500	Electric Cons. Co. British T-H.
Hampshire Light Railway (Elec.) Co.	March, 1903	6	9	4 8½	..	..	..	10	*				
Hartlepool Electric Tramways Co.	May, 1896	6·72	8·3	3 6	87 & 90 G	15	35	21	4	4	V. Cp.	..	Electric Cons. Co Dick, Kerr, & Co.
Haslingden Corporation	July, 1908	3	3	4 0	100 G	10	30	..	..	..	..	..	Dick, Kerr, & Co.
Hastings and District	July, 1905	19·33	34	3 6	90 G	8	36·75	65	6	6	V. Cp.	2,100	Dick, Kerr, & Co.
Herne Bay Pier (1)	March, 1899	·75	·75	3 0	60	..	..	3	1	1	Gas	50	British T-H.
Heywood Corporation	Dec., 1905	4·25	4·25	4 8½	90 G	17	..	..	3	3	..	..	Blackwell & Co. B.I. & H.C. Co.
Houghton-le-Spring (See Sunderland Dist. Elec. Trys.)													
Huddersfield Corporation	Feb., 1901	31·07	48·5	4 7¾	98 G	11	35	96	4	4	V. Cp. C.	2,200	British T-H.
Hull Corporation	July, 1899	13·46	30·5	4 8½	94 G	20	30	180	7	7	V. Cp. C.	2,560	British T-H. Westinghouse
Ilford Urban District	Mar., 1903	6·5	11·35	4 8½	95 G	13	33·3	26	*7	7	..	1,600	British T-H. Dick, Kerr, & Co.
Ilkeston Corporation	May, 1903	3·8	4·3	3 6	90 G	12	28	13	2	1	..	..	Dick, Kerr, & Co.
Ipswich Corporation	Nov., 1903	10·8	14·87	3 6	90 G	11·5	40	36	10	10	Enclos'd	1,175	Westinghouse
Isle of Man— Manx Elc. Rly. Co. Douglas to Ramsey	July, 1893	18	35·75	3 0	62½ V	24	90	65	9	9	H. Cp.	1 300	Mather & Platt
Manx Elc. Rly. Co. Snaefell Mountain	Aug., 1895	4·5	9·5	3 6	56 V	12	90						
Isle of Thanet Trys. & Ltg. Co.	April, 1901	11	20·67	3 6	90 G	11	38	59	*6	6	3 V. Cp. 3 H. Cp.	800	British T-H. Blackwell & Co.
Jarrow and District	Nov., 1906	2·54	3·42	4 8½	95 G	12·5	50	10	..	..	..	..	Brush Co. B.I. & H.C. Co.
Kearsley Urban District	Jan., 1902	1·75	1·75	4 8½	95 G	20	..	..	..	..	..	..	Westinghouse
Keighley Corporation	Oct., 1904	3·5	6·11	4 0	95 G	25	60	12	*4	4	V.	200	Blackwell & Co. Brush Co.
Kidderminster—Stourport British Electric Traction Co.	May, 1898	4·6	4·87	3 6	75 G	14	45	13	*5	5	Stm Turb.	..	Brush Elc. Eg. Co
Kilmarnock Corporation	Dec., 1904	4·18	5·5	4 8½	90 G	24	45	14	*3	3	..	250	Blackwell & Co.
King's Norton & Northfield U. D.	May, 1904	5·25	8·25	3 6	105 G	15&21	100&145	..	..	..	..	..	Blackwell & Co.
Kinver	April, 1901	4	4	3 6	63 & 90 G	..	..	6					
Kirkcaldy Corporation	Feb., 1903	6·11	8·56	3 6	100 G	11	40	22	*8	6	Cp. H.S.	1,090	British T-H. Co.
Lanarkshire Tramway Co.	July, 1903	21·21	34·4	4 7¾	96 & 101 G	9·4	37	60	4	4	3 H. Cp. 1 V. Cp.	825	British T-H. Co.
Lancashire United Tramways Co.	Oct., 1902	39	54	4 8½	90 G	15	50	82	*5	5	V. Cp. C.	2,750	B. I. W. Co.
Lancaster Corporation	Jan., 1903	4	4·81	4 8½	90 G	8	30	12	4	4	V. Cp.	200	Greenwood & Batley, Ltd.
Leamington & Warwick Elec. T. Co.	July, 1905	3·04	6·1	3 6	65 G	12	47	12	3	3	Cp.	..	Brush Co.
Leeds City	Aug., 1897	69·02	114·62	4 8½	105 & 111 G	8·4	32	345	5 3	5 3	H. Cp. C. Stm. Tur	6,150	Elec. Con. Co. Greenwood & Batley, British T-H Blackwell & Co.

* Current from combined lighting and traction station. (1) Third Rail system.

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ELECTRIC TRAMWAYS & RAILWAYS.—Particulars of Track and Equipment.

Location of Line and Name of Operating Company.	Date of Opening of First Section.	Length of Route.	Total length of Track.	Gauge.	Weight and Type of Rail.	Maximum Gradient.	Sharpest Curve.	No. of Motor Cars.	No. of Dynamos	No. of Engines	Type of Engines.	Total Capacity Traction, kw.	Principal Contractors for Electrical Equipment.
TRAMWAYS—*continued.*				ft. in.	lbs.	1 in	ft. rad.						
Leicester Corporation	May, 1904	20	37	4 8½	100 G	16	35	160	4	4	V. Cp.C.	2,500	Dick, Kerr, & Co. / Blackwell & Co.
Leith Corporation	Aug., 1905	9·08	17·9	4 8½	106·7 G	19	54	37	*11	11	..	1,600	Brush Co.
Leyton Urban District	Dec., 1906	9·125	18·5	4 8½	105 & 111 G	24	45	60	*8	8	Cp.	1,600	..
Lincoln Corporation (1)	Nov., 1905	1·75	2·96	4 8½	100 G	..	..	8	*8	8	..	645	Blackwell & Co.
Liverpool Corporation	Nov., 1898	63	119	4 8½	95 & 98 G	13	40	596	*55	55	V. Cp. Trip Exp	35,300	British T-H. / Dick, Kerr, & Co. / Westinghouse
Liverpool Overh'd Ry. (Trol. Ln. Ex.)	June, 1900	2·5	2·5	4 8½	92½ G	Nil	40	14	7	7	H. & V. Cp.	160	Dick, Kerr, & Co.
Llandudno and Colwyn Bay ..	Oct., 1907	6·60	7·573	3 6	90 G	11·5	45	18	*	..	..	..	Bruce Peebles & Co.
Llanelly and District	July, 1911	6·25	6·75	4 8½	90 G	..	..	10	*2	2	Trip. Ex.	..	
London County Council (2) ..	May, 1903	142·98	279·3	4 8½	105 G	11	45	1722	..	..	V. Cp. C. / Turbine	..	Dick, Kerr, & Co. / Westinghouse
London United Tramways Co. ..	April, 1901	55·25	102·45	4 8½	92½ & 100 G	18	28	339	7	5	V. Cp.	3,500	British T-H. / Westinghouse. / Blackwell & Co.
Lowestoft Corporation	July, 1903	4·75	5·07	3 6	100 G	27	36	19	*5	5	Cp.	..	Blackwell & Co.
Luton Corporation Tramways (Leased to J. G. White & Co., Ltd.) ..	Feb., 1908	5·25	6·25	4 8½	95 G	11	35	12	*1	1	..	..	J. G. White & Co.
Maidstone Corporation	July, 1904	5·5	7·04	3 6½	96 G	9	35	19	6	6	..	300	Dick, Kerr & Co.
Manchester Corporation	June, 1901	119·76	202·7	4 8½	105 G	14·9	35	683	*22	22	Turb'nes	45,300	British T-H. / Dick, Kerr, & Co
Mansfield and District Co. ..	July, 1905	10	12·25	4 8½	90 G	17	50	20	*3	3	..	..	
Merthyr	April, 1901	2·98	3·94	3 6	96 G	11	66	16	*4	4	H.S.V.	..	Dick, Kerr, & Co.
Metropolitan Electric Trys., Ltd.	July, 1904	52·5	105	4 8½	100 G	12	40	312	5	5	1 Stm. Tur	..	British T-H. / Brush Co.
Mexborough & Swinton Trys. Co.	Feb., 1907	7·75	10·75	4 8½	90 G	8·5	55	20	3	3	..	1,300	Brush Co.
Middlesbro', Stockton, & Thornaby Electric Tramways Co.	July, 1898	10·5	15·825	3 6	92½ G	17	35	60	3	4	H. & V. Cp.	900	British T-H. / Blackwell & Co.
Middlesex County Council	Aug., 1904	25·5	51	4 8½	..	..	..	..	..	..	..	..	
Middleton Corporation	March, 1902	2·5	5	4 8½	..	..	..	..	..	..	..	..	
Middleton Electric Traction Co. ..	March, 1902	8·5	10·53	4 8½	90 G	15	49½	28	3	3	..	500	Glover & Co.
Musselburgh and District ..	Dec., 1904	6·5	8·125	4 8½	90 G	34	45	16	4	3	..	400	B. T-H. Co., Nat. Elec. Cons. Co.
Nelson Corporation	Feb., 1903	2·74	3·86	4 0	106 G	11	41	11	*4	4	..	400	Blackwell & Co. / British T-H. Co. / Brush Co.
New St. Helens & District Trys. Co.	July, 1899	18	20	4 8½	95 G	13	35	36	*4	4	V. Cp. C.	..	Westinghouse / British T-H.
Newcastle Corporation	Dec., 1901	31·25	61	4 8½	101 G	11	35	200	5	5	V. Cp.	..	Westinghouse / British T-H.
Newport (Mon.) Corporation ..	April, 1903	7·5	14·35	4 8½	98 G	10·5	40	44	5	5	V. Cp.	1,750	Westinghouse
Northampton Corporation	July, 1904	5·5	9·16	3 6	90 & 96 G	18	50	26	3	3	V. C. C.	520	Dick, Kerr, & Co. / Brush Co.
North Shields Tramways Co. ..	March, 1901	..	7·75	3 6	90 G	10	36	22					
North Staff. Trys. (*vide* Potteries)													
Norwich Electric Tramways Co. ..	July, 1900	14·5	19·25	3 6	65½ & 90 G	12·6	38	52	4	4	H. T. Cp.	800	Westinghouse / Blackwell & Co.
Nottingham Corporation	Jan., 1901	19·75	37·5	4 8½	107 G	11·5	40	155	3	3	..	..	British T-H. / Dick, Kerr, & Co.
Nottinghamshire & Derbyshire Tramways Co.	Aug., 1913	12·8	16·10	4 8½	G	..	..	24	*				
Oldham, Ashton & Hyde Trys. Co.	June, 1899	8·888	11·183	4 8½	97 G	11	28	46	*3	3	V. Cp. C.	..	British T-H.
Oldham Corporation	Dec., 1900	23·42	36·5	4 8½	100 & 102 G	10·5	40	92	*4	4	..	2,220	Dick, Kerr, & Co.
Paisley & District Tramways Co.	June, 1904	15	25	4 7⅞	90 G	10	34	58	..	..	..	..	
Perth Corporation	Oct., 1905	4·846	6·75	3 6	90 G	16	25	12	5	5	Cp.	500	Blackwell & Co.
Peterborough Elec. Traction Co. ..	Jan., 1903	5·33	6·71	3 6	94 G	31	35	14	..	..	..	..	Blackwell & Co. / Dick, Kerr, & Co.
Plymouth Corporation	Sept., 1899	7·75	15	3 6	92 G	9	35	42	3	3	V. Cp.	..	Elec. Cons. Co. / Westinghouse
Plymouth, Stonehouse, and Devonport	Nov., 1901	1·5	3·62	3 6	84 G	11	34	14	..	..	..	..	Blackwell & Co. / Dick, Kerr, & Co.
Pontypridd Urban District ..	March, 1905	5·5	8·6	3 6	96 & 100 G	10	27·6	26	4	4	V. C. Cp.	450	B. I. W. Co. / Blackwell & Co.
Portmadoc & South Snowdon Rly.	Under cons.	13·25	15	1 11½	41	28	200	6	..	..	..	..	
Portsdown & Horndean Tramway	March, 1903	6	7·5	4 7⅞	96 G	16	40	16	2	2	Oil	200	Dick, Kerr, & Co. / Brush Co.
Portsmouth Corporation	Sept., 1901	15·75	30·83	4 7⅞	96 & 100 G	17	35	100	5	4	V. & H. Cp.	2,075	Macartney & Co. / Dick, Kerr, & Co.
Potteries Electric Traction Co. ..	May, 1899	31·67	41·48	4 0	87, 90, 100, & 110 G	11	45	110	8	8	H. Cp. / V. Cp.	2,275	Dick, Kerr, & Co. / Blackwell & Co.
Preston Corporation	June, 1904	10·54	17·2	4 8½	95 G	16	28	33	2	2	H. Cp.	600	Dick, Kerr, & Co.
Radcliffe Urban District ..	April, 1905	5	6·5	4 8½	100 G	15	40	..	3	2	V. Cp.	..	Mather & Platt
Rawtenstall Corporation	May, 1909	12	15·9	4 0	100 G	15	38	24	*3	3	..	850	Westinghouse
Reading Corporation	July, 1903	7·44	13·175	4 0	96 G	16	35	36	4	4	V. Cp.	400	Blackwell & Co. / Dick, Kerr, & Co. / Westinghouse
Rhondda Tramways Co.	July, 1908	17·5	24·5	3 6	95 G	15	45	50	8	4	..	1,400	British T-H. / Brush
Rochdale Corporation	May, 1902	19·58 (A)	22·74 (A)	4 8½	103½ G	11·7	30	69	..	..	..	..	British T-H. / Dick, Kerr, & Co. / Brush Co.
Rotherham Corporation	Jan., 1903	10	12	4 8½	100 G	9·5	45	36	*6	6	H.S. Cp.	1,485	Dick, Kerr, & Co.
Rothesay	June, 1902	4·81	9·68	3 6	94 G / 77 G	24	34	20	3	3	V. & Oil	350	Dick, Kerr, & Co. / Westinghouse
Ryde Pier, Isle of Wight Ryde Pier Co. (3) ..	March, 1886	·5	1	4 8½	30 & 34 V	..	..	4	2	2	Gas	..	Siemens Bros.
Salford Corporation	Oct., 1901	41·25	75·79	4 8½	103 G	20	47	200	*8	9	V. Cp. C.	2,400	Westinghouse / Mather & Platt
Scarborough Tramways Co. ..	May 1904	5	7·75	3 6	90 G	10·5	35	22	2	2	Stm. Turb.	..	Brush Elec. Co.
Sheerness and District	April, 1903	2·5	2·704	3 6	94 G	43	40	8	6	5	V. Cp. C.	100	Siemens & Halske / Brush Co.
Sheffield Corporation	Sept., 1899	40	77·84	4 8½	110 & 116 G	9·5	35	339	7	7	1 H. Cp. / 6 V. Cp.	5,725	British T-H.

* Current from combined lighting and traction station. (1) G.B. surface contact system. (2) Mainly Conduit system, but there are now several Trolley lines. Besides the electric lines the London County Council has also 4·45 route miles of horse tramways. (3) Third rail system. (A) Not including 17·1 miles track leased.

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ELECTRIC TRAMWAYS (contd.).	Date of Opening of First Section.	Length of Route.	Total Length of Track.	Gauge.	Weight and Type of Rail	Maximum Gradient.	Sharpest Curve.	No. of Motor Cars.	No. of Dynamos	No. of Engines	Type of Engines.	Total Capacity Traction, kw.	Principal Contractors for Electrical Equipment.
				ft. in.	lbs.	1 in	ft. rad.						
Shipley Urban District	May, 1902	6	10	4 0	98 G	15	..	..	4	3	..	..	British T-H.
Soothill Nether U.D.C. & Dewsbury & Ossett Corporations ..	Nov., 1908	3·125	4·45	4 8½	90 G	13	50	8	*	..	..	..	Nat. Elec. Cons. Co.
Southampton Corporation	Jan., 1899	10·25	18·5	4 8½	96 G	13	45	70	6	6	H. Cp. C.	1,000	Westinghouse
Southend Corporation	July, 1901	7·01	10·24	3 6	90 G	18	48	31	*6	6	V. Cp. Con.	2,075	British T-H.
Southend Pier (1) Southend Corp.	Aug., 1890	1·25	1·25	3 6	60 G	Lev.	..	25	..	..	..	..	British T-H.
South Metropolitan Elec. Try. Co.	Feb., 1906	13·09	26	4 8½	95 G	16	42	51	*8	6	Stm Tbs	1,650	Dick, Kerr & Co. / Brush Co.
Southport Corporation (5)	July, 1900	13·5	10·75	4 8½	87 & 90 G	25	45	26	*3	3	H. Cp.	600	Dick, Kerr, & Co.
Southport Electric Tramway Co...	July, 1901	8·17	12·52	4 8½	87 G	Nil	40	21	*				
Southport Pier	1905	1	1	4 0	..	..	..	3	..	..	..	..	Westinghouse
South Shields Corporation ..	March, 1906	5·7	10·25	4 8½	95 G	15	35	35	2	2	V. Cp. C.	1,100	Dick, Kerr & Co.
South Staffordshire	Jan., 1893	18·98	29·5	3 6	97 & 90 G	17	46	46	3	3	C.H. Cp.	..	Blackwell & Co. / E. C. C.
Stalybridge, Hyde, Mossley, and Dukinfield	May, 1904	23·75	27·75	4 8½	99 G	9	27½	60	9	3 / 2	Marine / Stm. tur.	7,900	Dick, Kerr, & Co.
Stockport Corporation	Aug., 1901	16	27·62	4 8½	96 G	10·8	35	50	*5	5	Cp.	1,000	Dick, Kerr, & Co.
Sunderland Corporation	Aug., 1900	10·92	20·35	4 8½	96 G	12	36	70	*4	4	..	936	Dick, Kerr, & Co.
Sunderland District Electric Trys.	June, 1905	14·27	15·97	4 8½	90 G	11	40	33	*				
Sutton & Howth (G.N.R., Ireland)	June, 1901	5·3	6	5 3	72 B	16·7	300	11	3	3	V. Cp.	500	British T-H. / Westinghouse
Swansea Tramways Company ..	June, 1900	12·43	18·54	4 8½	84 & 86 G	14	45	65	3	3	H. Cp. C.	620	British T-H.
Swindon Corporation	Sept., 1904	3·7	4·4	3 6	105 G	15	37	12	5	4	..	600	Dick, Kerr & Co.
Taunton Electric Traction Co.	Aug., 1901	1·66	2	3 6	90 G	25	35	6	*	..	..	..	Blackwell & Co.
Torquay Tramways	April, 1907	6·95	11·125	3 6	90 G	12	45	18	*2	1	..	..	
Trafford Park Estates, Ltd. (Trys.)	July, 1903	2·5	2·75	4 8½	100 G	Nil	35	7	4	4	Tand Cp.	..	Westinghouse
Tynemouth and District	March, 1901	4·21	7·83	3 6	90 G	10	30	21	*3	3	..	..	Blackwell & Co.
Tyneside Tramways & Tramroads Co.	Sept., 1902	10·97	16·23	4 8½	95 G	10	40	24	*				
Wakefield & District Lgt. Rlys. Co.	Aug., 1904	24·69	40·382	4 8½	96 G	15·5	40	69	5	5	..	1,200	Dick, Kerr, & Co.
Wallasey Corporation	March, 1902	8·75	19·86	4 8½	98 G	14	40	61	*3	3	V. Cp. C.	1,100	Blackwell & Co.
Walsall Corporation	Jan., 1904	13·5	19·5	3 6	90 & 92 G	18·5	32	39	*8	8	V. Cp. C.	1,730	British T-H. / Electric Cons. Co.
Walthamstow U.D.C. Light Rly...	June, 1905	9·14	12·53	4 8½	100 G	18	40	38	*15	15	Gas	1,560	Westinghouse
Walton-on-Naze Pier	Aug., 1898	·5	·5	3 6	36 V	..	..	3	3	2	..	100	Blackwell & Co.
Warrington Corporation	April, 1902	6·5	9·6	4 8½	90 G	27	50	21	*6	6	V.C.	500	British T-H.
Wemyss and District	Aug., 1906	7·5	9	3 6	95 & 97 G	18	85	17	3	3	2 V.Cp.	..	Bruce Peebles & Co
West Bromwich Corporation ..	Dec., 1902	7	12·5	3 6	98 G	20	49	29	8	8	Turb'nes	750	Dick, Kerr, & Co. / B. I. W. Co.
West Ham Corporation	Feb., 1904	15·5	30·05	4 8½	100 G	18	40	118	*3	3	V.C.Cp.	1,500	Brush Co.
Weston-super-Mare	May, 1902	2·39	3·5	4 8½	90 G	25	40	12	5	4	Cp.	..	Blackwell & Co. / British T-H. / Brush Co.
Wigan Corporation	Jan., 1901	30·9	45·42	3 6 / 4 8½	105 G	12	45	67	*8	8	..	740	Blackwell & Co.
Wolverhampton Corporation (3) ..	April, 1902	13·5	21·5	3 6	91 G	15	37·5	52	*10	10	H. & V.C. & Turb's	2,900	British T-H. / Electric Cons. Co.
Wolverhampton District	April, 1900	14·75	19	3 6	90 G	20	40	30	*4	..	..	..	B.I.W. & B.T-H. / Westinghouse
Worcester Electric Traction Co. ..	Feb., 1904	5·86	8·58	3 6	94 G	13	45	15	*3	3	..	..	Brush Co. / Dick, Kerr, & Co.
Wrexham and District	April, 1903	4·44	6·16	3 6	96 G	9·11	50	10	*6	..	..	..	British T-H.
Yarmouth Corporation	June, 1902	10	14·4	3 6	90 & 95 G	27	48	35	3	3	Comp.	..	Brush Co. / B.I.W. Co.
York Corporation	Jan., 1910	6	9·9	3 6	100	18	40	31	*8	8	V.C.	..	Dick, Kerr, & Co. / Brush Co.
Yorkshire Woollen District ..	Feb., 1903	22·25	36	4 8½	94 & 100 G	8	30	69	*	..	..	..	Brush Co. / Dick, Kerr, & Co.
RAILWAYS.													
LONDON AND VICINITY:													
Central London Rly. Co. (1) ..	July, 1900	6·5	13	4 8½	100 V	30	..	68 M. 172 T.	6	6	H. Cp. C.	..	British T-H
City & South London Rly. Co. (1)	Dec., 1890	7·25	14·75	4 8½	60 V / 80 V	30	120	52 L. 142 T.	(a)	..	..	..	Mather & Platt / Elec. Cons. Co. / British T-H.
East London Railway (2) ..	April, 1913	5·75	11·5	4 8½	90 B	..	..	(c)	..	..	..	..	
Gt. Northern & City Rly. Co. (2)	Feb., 1904	3·5	7·75	4 8½	85 V	52	660	35 M. 45 T.	6	..	..	..	British T-H.
Great Western Railway .. (Hammersmith and City line.)	Nov., 1906	4·9	10·5	4 8½	97½ B	60	400	40 M. 80 T.	10	10	V.Cp.	..	British T-H. / Elec. Con. Co.
London & North Western Rly. (Euston-Watford line in progress) (2)	May, 1914	41·5	80	4 8½	..	..	..	..	..	..	Turbine	..	Siemens Works / Westinghouse
London & South Western Rly. (Extensions in progress) (1)	Under cons.	47	150	4 8½	..	..	168	84	..	..	Turbine	..	Dick, Kerr & Co. / British T-H. / Westinghouse
London, Brighton, and South Coast Railway (4) .. .. (Extensions in progress)	Dec., 1909	22	70	4 8½	..	..	..	16 M. 8 T.	*(d)	..	..	..	British T-H. / Blackwell & Co.
London Electric Railway Co.:													
Baker St. & Waterloo Ry. (2)	March, 1906	7	14·0	4 8½	90 B	60	330	86 M. 72 T.	(a)	..	..	..	Westinghouse / British T-H.
Charing Cross—Hampstead Railway (2)	June, 1907	8	16·5	4 8½	90 B	33	330	60 M. 90 T.	(a)	..	..	..	Westinghouse / British T-H.
Great Northern, Piccadilly & Brompton Rly. (2)	Dec., 1906	9·25	18·5	4 8½	90 B	33	330	72 M. 144 T.	(a)	..	..	..	Westinghouse / British T-H.
Metropolitan Railway (2) ..	Jan., 1905	26	59	4 8½	86 B	44	363	86 M. 172 T.	4	4	Turbine	..	Westinghouse / British T-H.
Metropolitan District Railway (and running powers) (2)	July, 1905	41	80·46	4 8½	86 B	40	330	334 M. 286 T.	(a)	..	Turbine	..	British T-H. / Westinghouse
Waterloo and City Rly. (1) ..	Aug., 1898	·7	1·5	4 8½	87 B	30	321	17 M. 12 T.	6	6	V. C.	..	Siemens Bros. / Dick, Kerr & Co.
PROVINCES:													
Lancashire and Yorkshire (2) .. (Extensions in progress)	March, 1904	31	65	4 8½	86 B	85	840	88 M. 52 T.	6	5	1 V.C / 4 H.C.	..	Dick, Kerr, & Co.
Liverpool Overhead Rly. Co. (1)	March, 1893	6·5	13·05	4 8½	60 V	40	429	46 M 7 T	7	7	H.Cp. / V.Cp.	..	Electric Cons. Co. / Dick, Kerr, & Co.
Mersey Railway (1)	April, 1903	4 5	9	4 8½	86 B	27	528	24 M. 37 T.	5	5	V.Cp.	..	Westinghouse / Elec. & Mfg. Co
Midland Rly.—Morecambe and Heysham Branch (4)	June, 1908	9·75	19·5	4 8½	..	..	..	8 M. 6 T.	4	4	Gas.	..	Westinghouse / Siemens Bros.
North Eastern Railway (1) ..	March, 1904	35	80	4 8½	90 B	55	792	60 M. 50 T.	(b)	..	..	..	British T-H. Co.

*Power from combined lighting and power station. (1) Third rail system. (2) Third and fourth rails system. (3) Lorain surface contact system. (4) Single phase. (5) Not including 9 miles owned but leased. (a) Power supplied by Chelsea Power Station (80,000 H.P.) (b) Power purchased from the Newcastle-upon-Tyne Electric Supply Company, Limited. (c) Rolling stock supplied by Metropolitan Railway. (d) Power supplied by London Electric Supply Corporation.
M—Motor Cars. T—Trail Cars.

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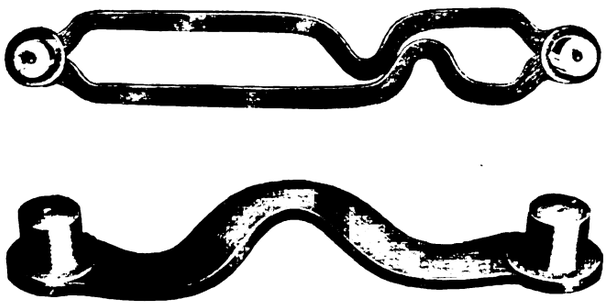

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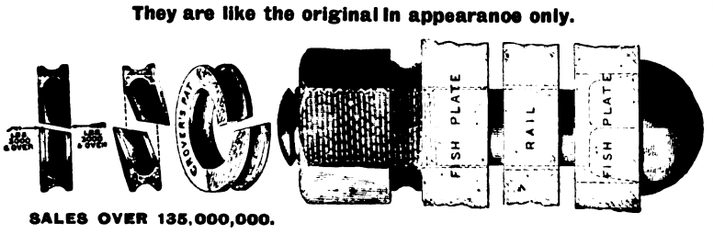

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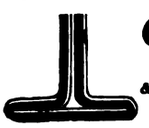

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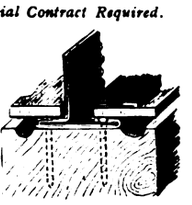

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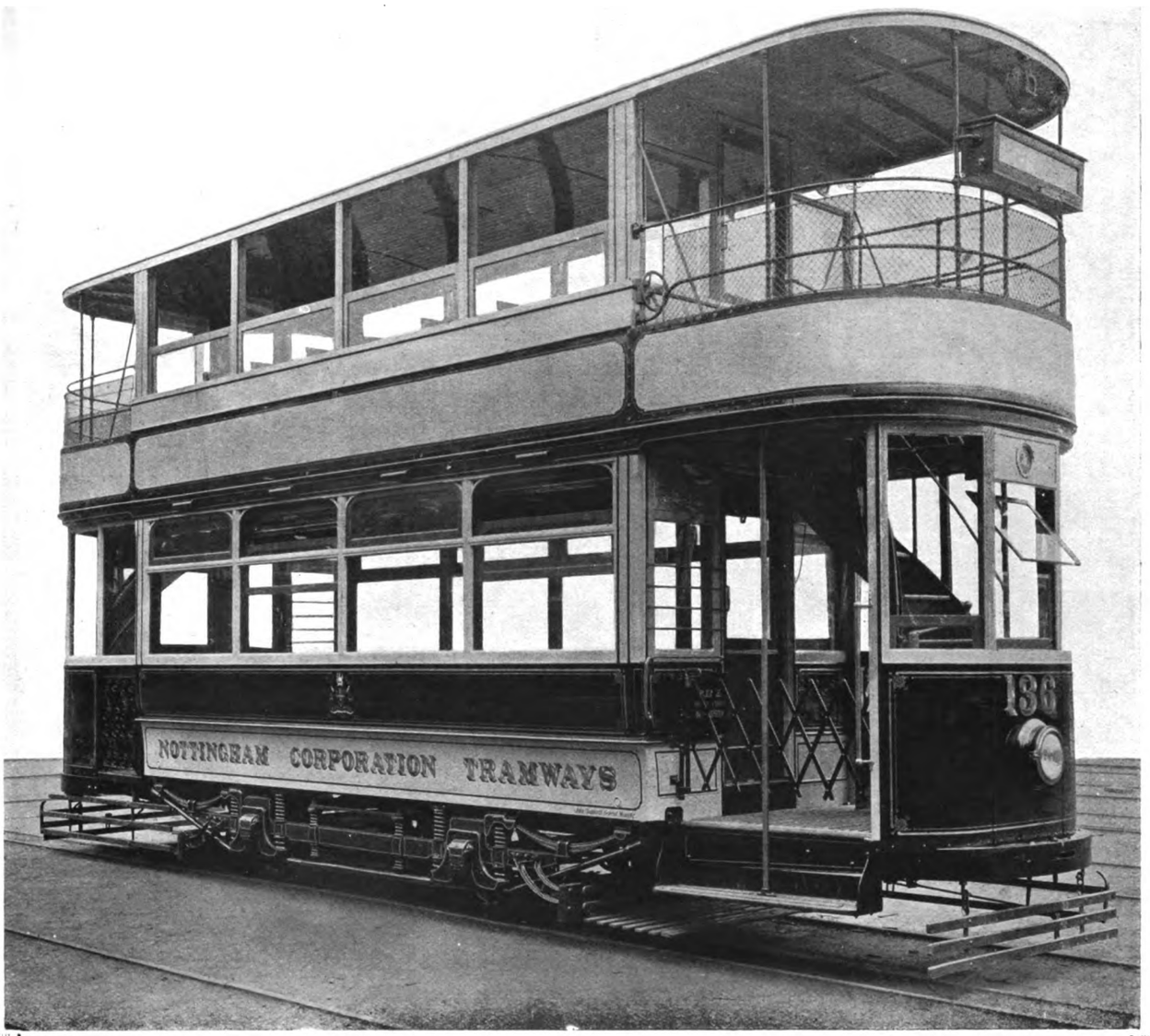

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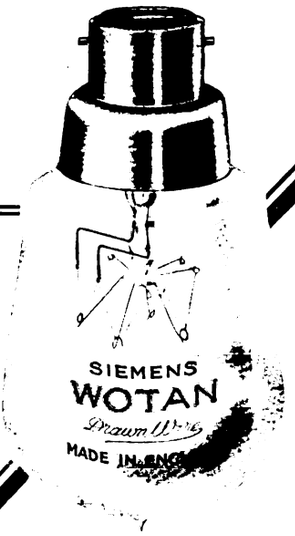

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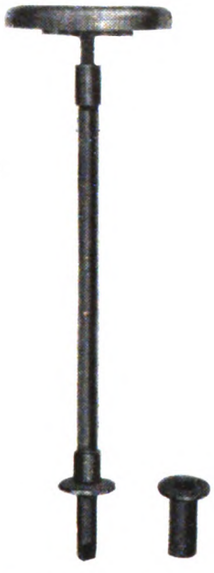

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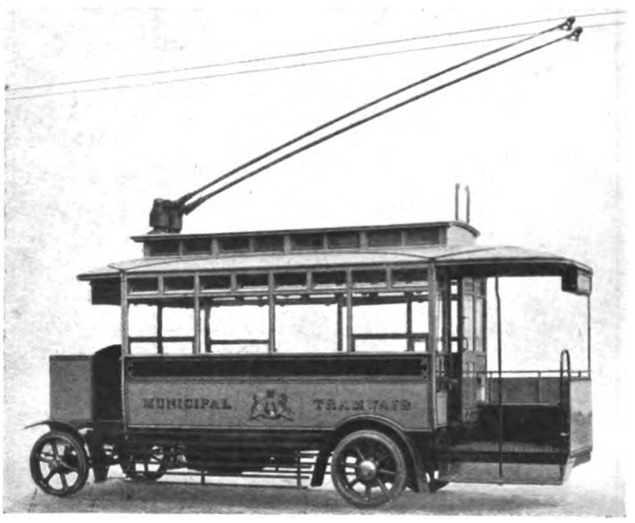

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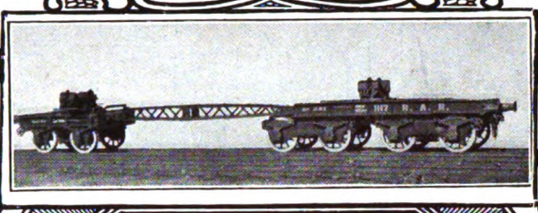

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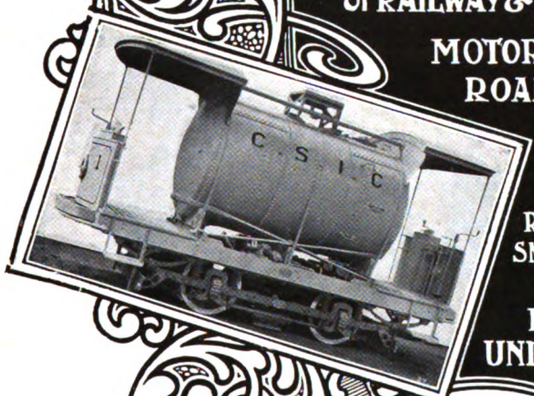

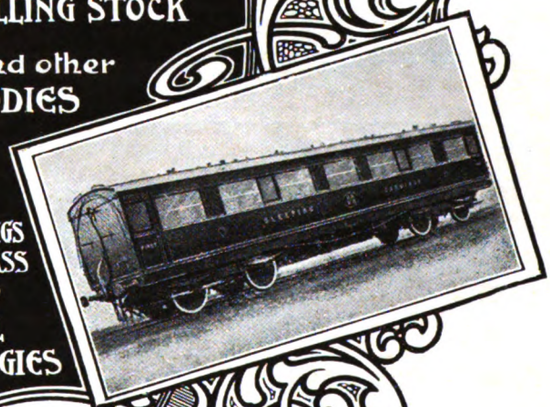

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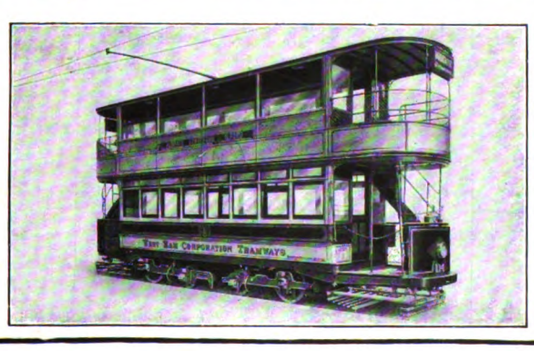

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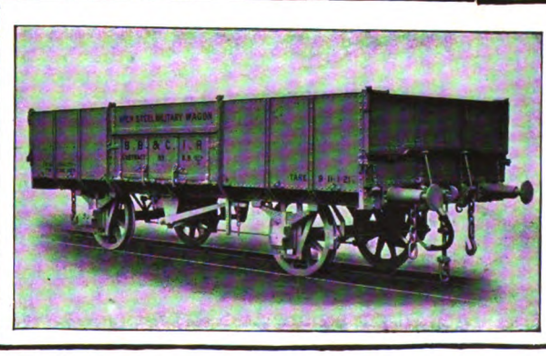

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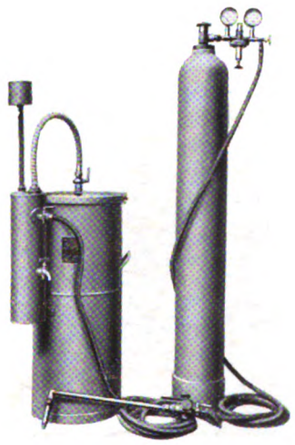

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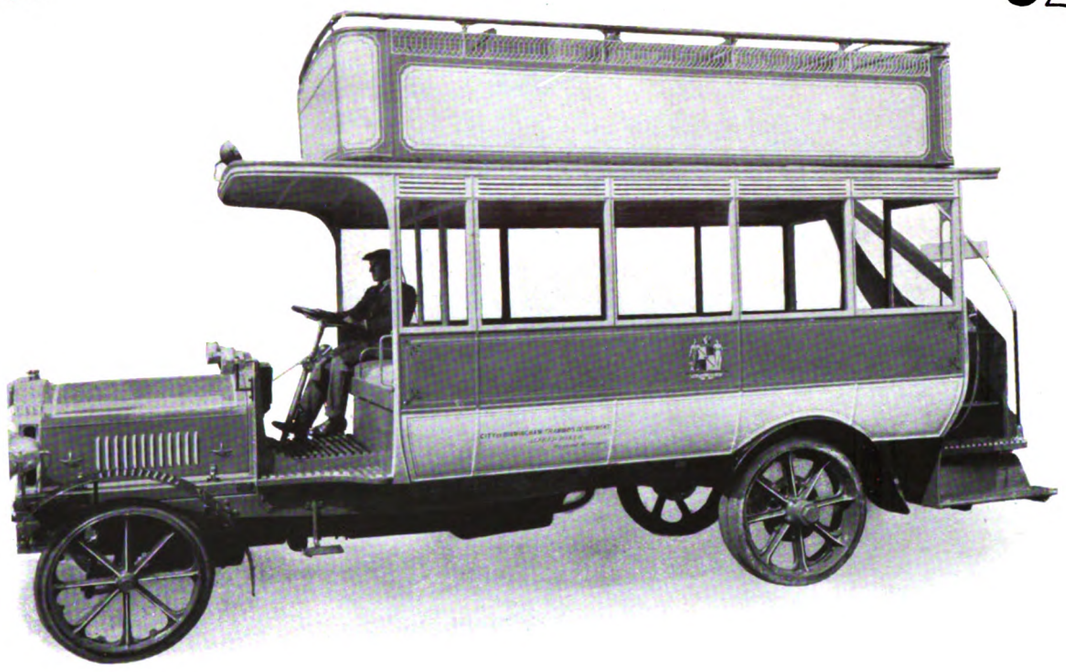

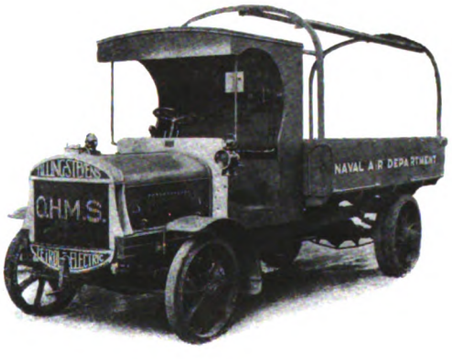

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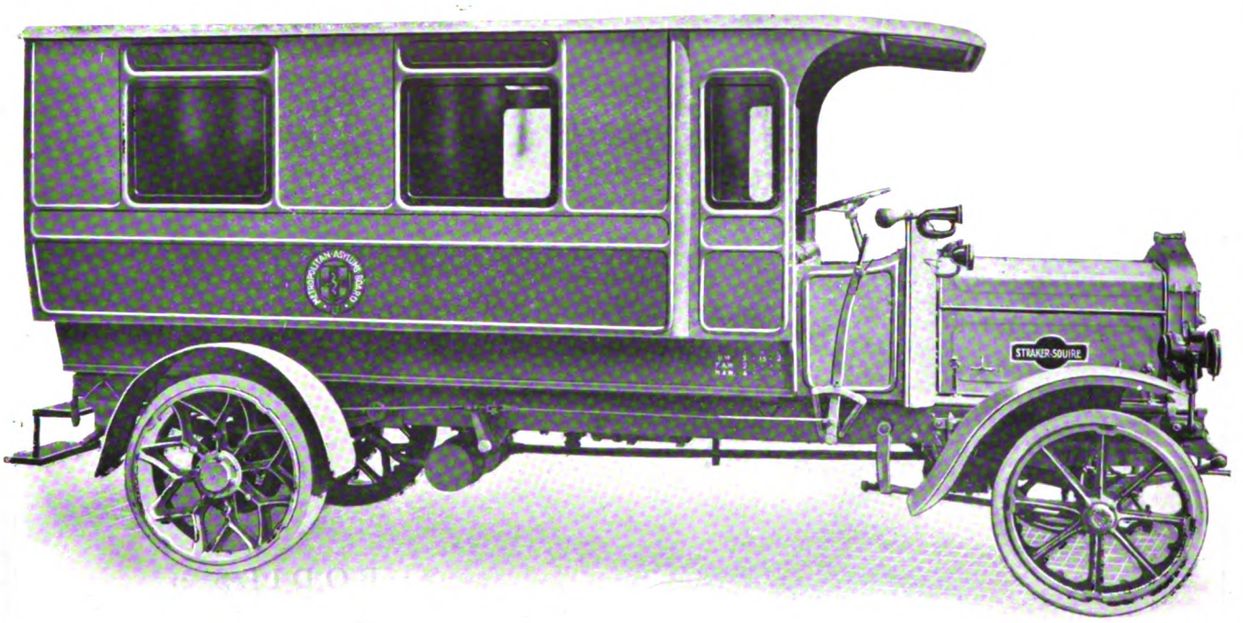

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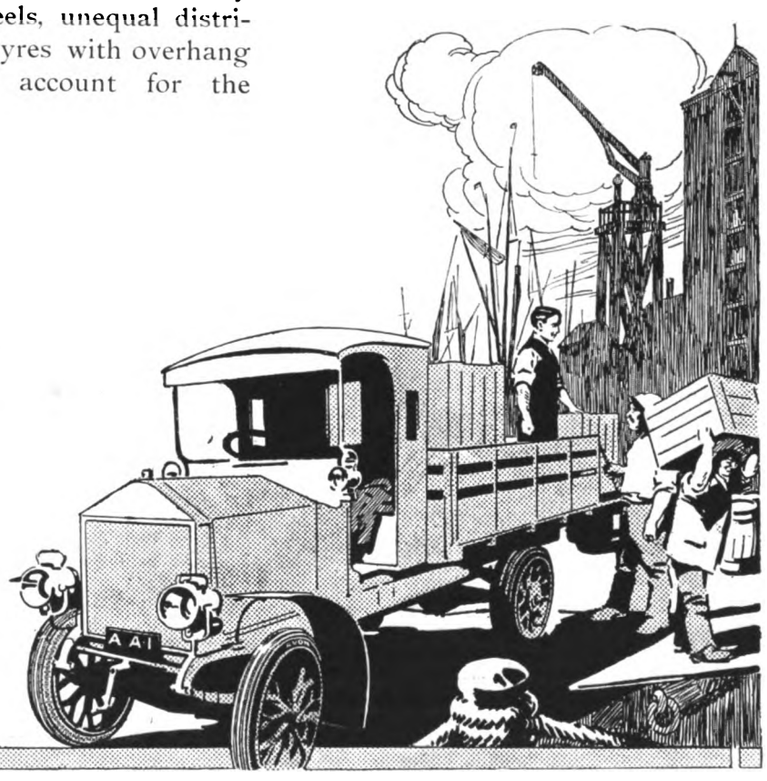

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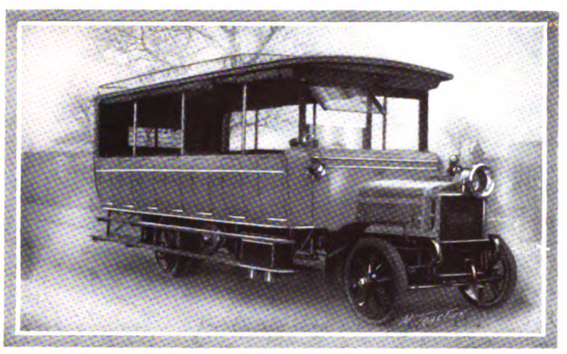

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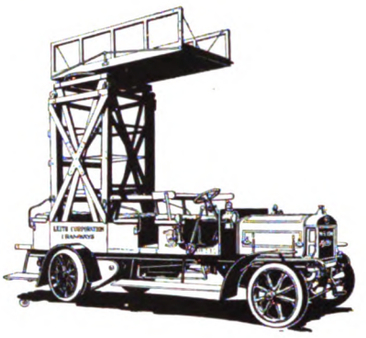

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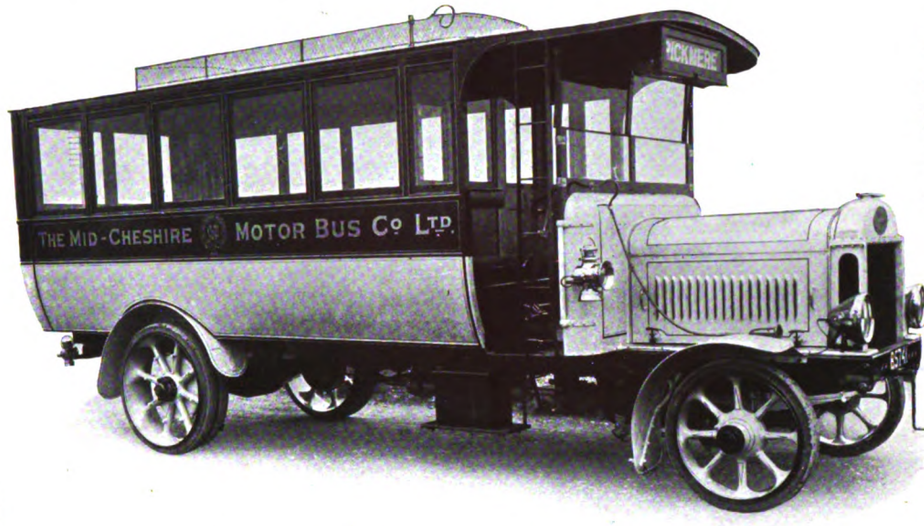

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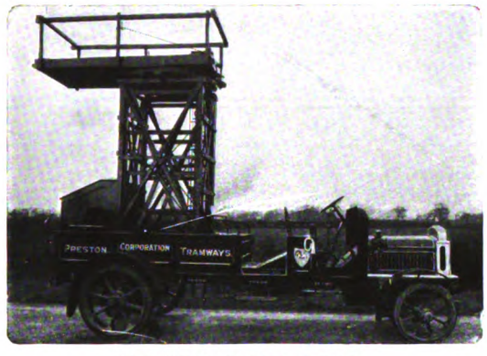

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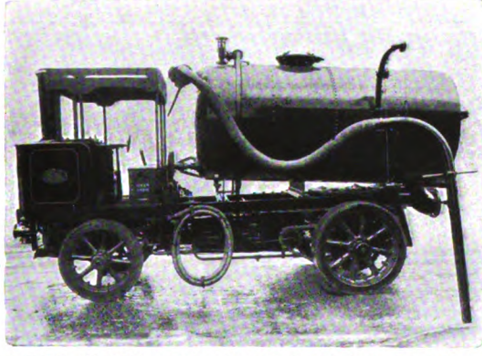

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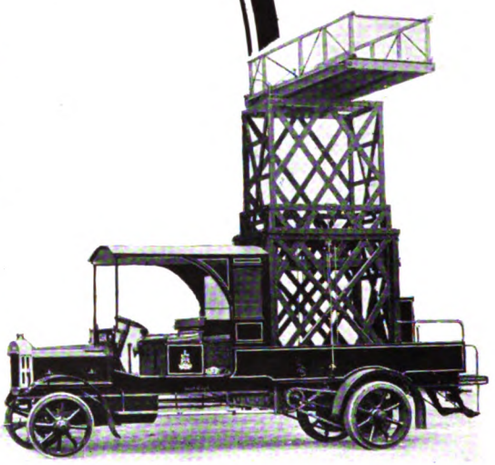

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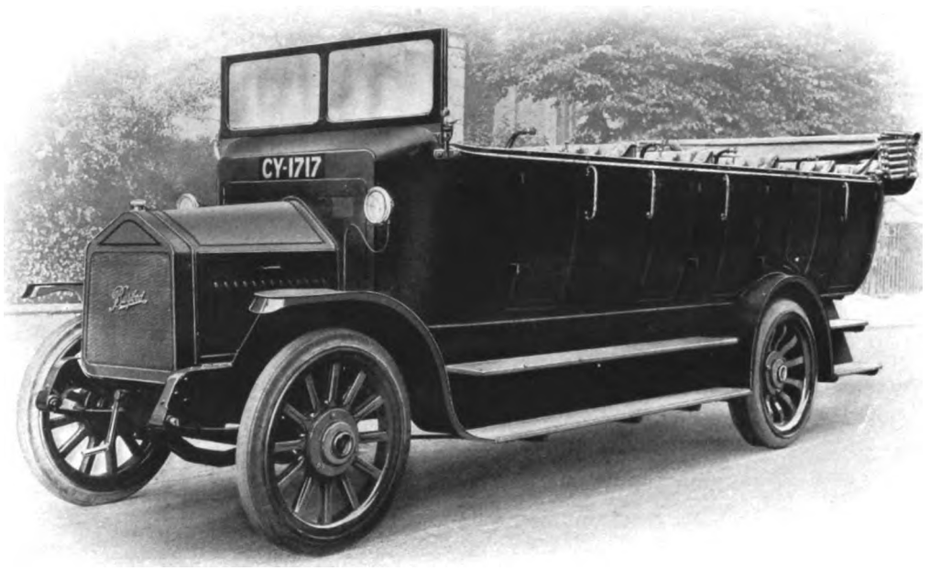

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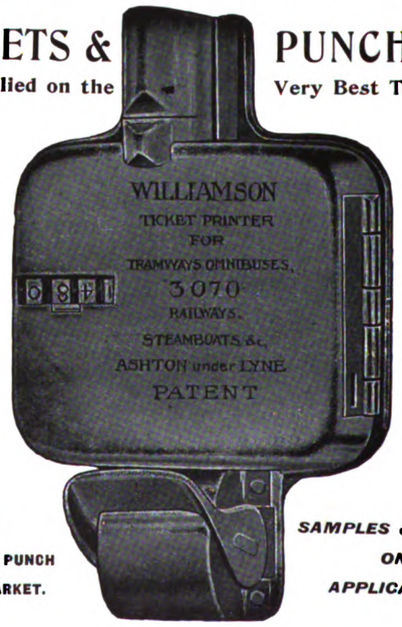

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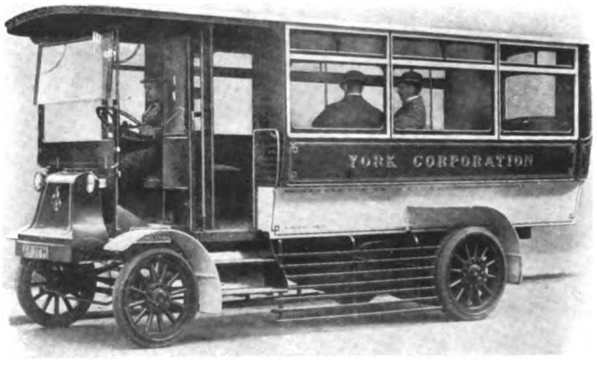

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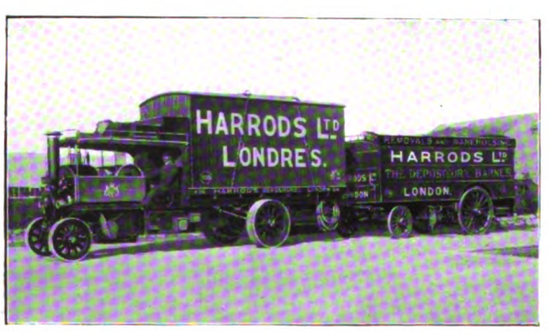

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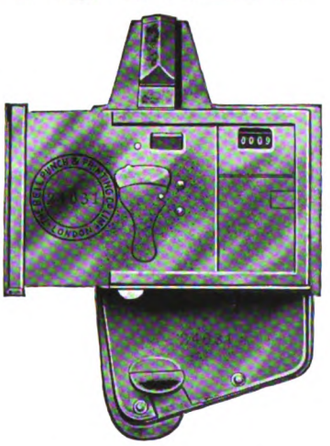

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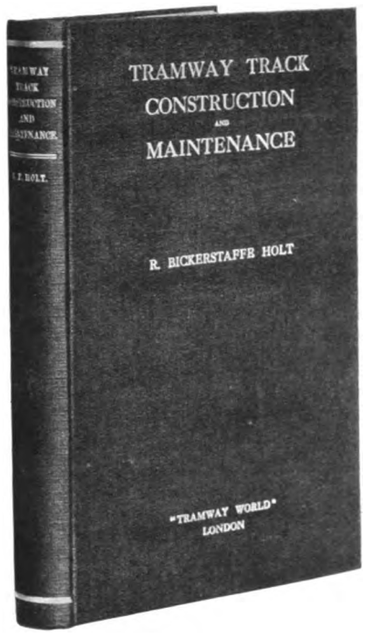

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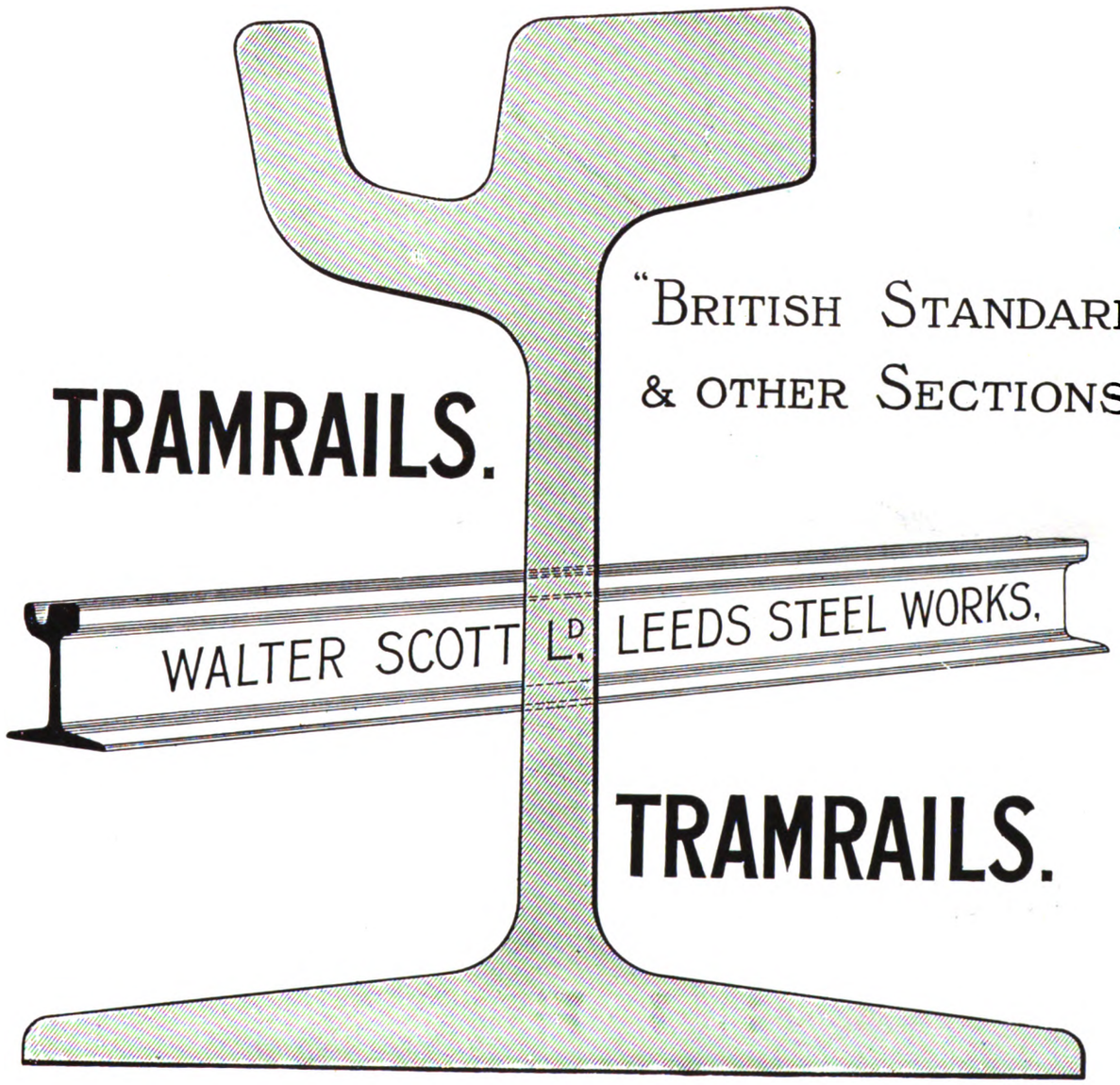

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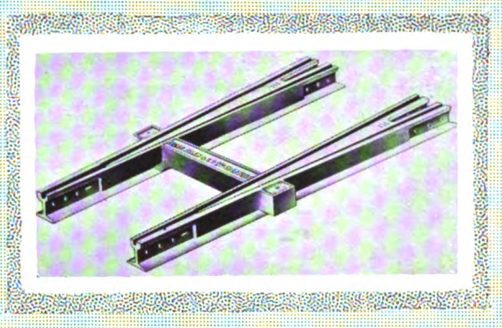

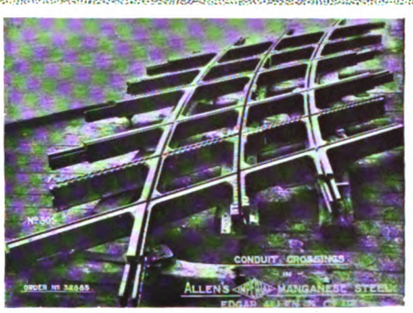

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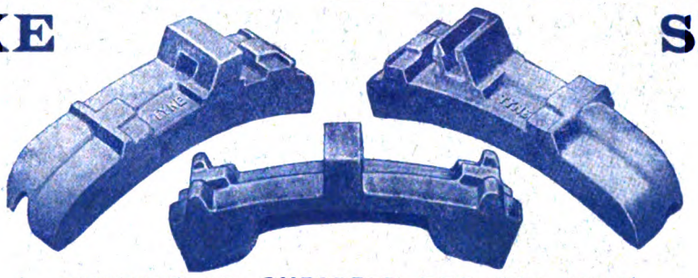

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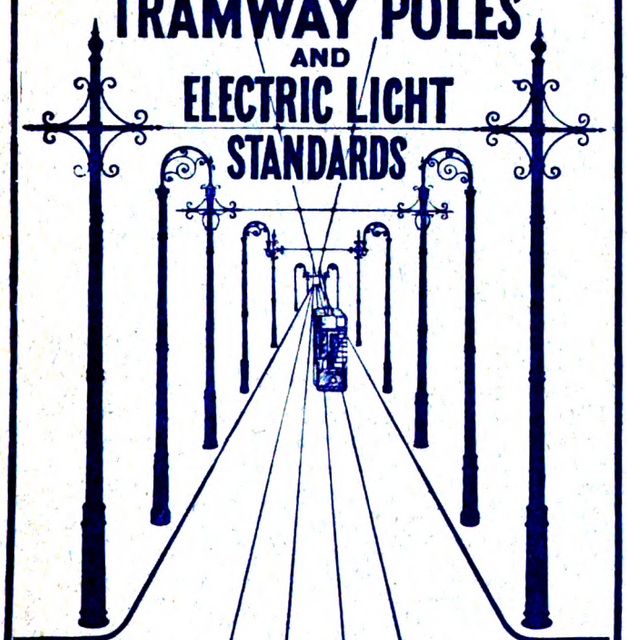

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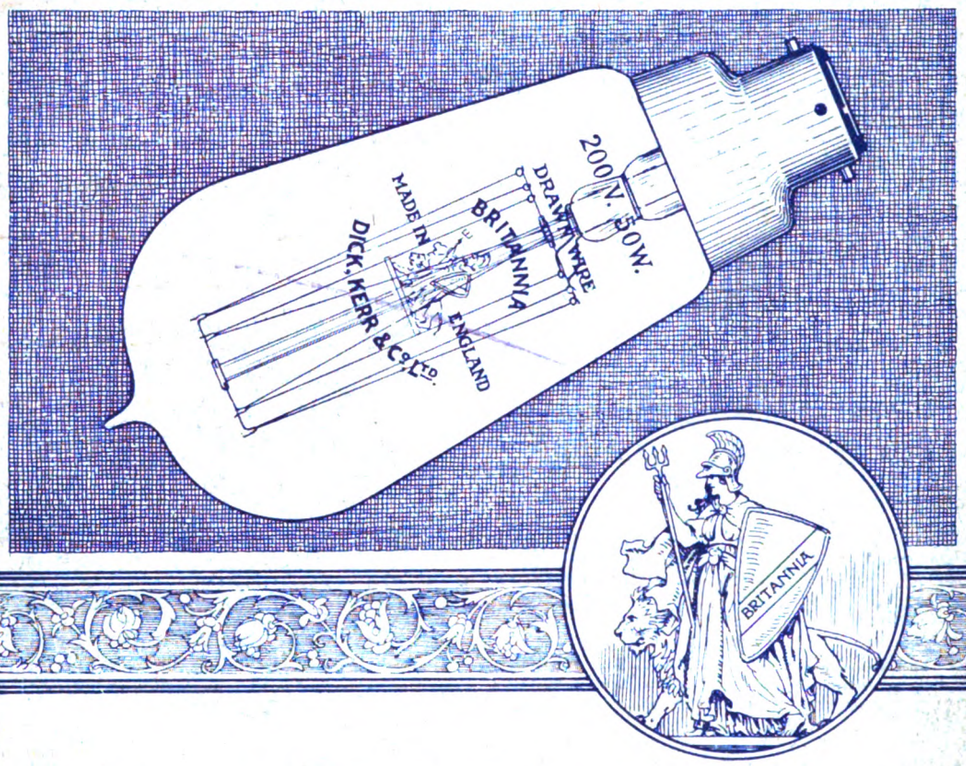

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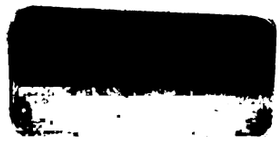

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